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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

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NOTES AND COMMENTS.

Line Cracks in Steel.

An interesting investigation of the cause of line cracks in forged steel has recently been made by E. H. Schultz and J. Goebel and is published in "Stahl und Eisen." They point out that these cracks appear in the longitudinal direction of rolled or forged bars and sometimes appear as a fibrous surface on the bar, or are disposed in a step-like formation. Oberhoffer, who refers to them as schistose cracks, was the first to investigate this problem, and attributed their presence to the unequal distribution of the sulphur and phosphorus and to the pressure of slag inclusions. Should this be the case, it will readily be admitted that, when metal shows a tendency to exhibit line cracks, the phosphorus content is high or that it has segregated and shows concentrations high in this element. Heat treatment will, therefore, be useless in this case.

According to Kuhnel, they result from the presence of a central pipe or subcutaneous blowhole in the ingot.

Schultz and Goebel, during a study of rolled bars and hollow bodies made by the Erhardt process, found these line cracks which could not be explained by the hypothesis of either Oberhoffer or Kuhnel.

For instance, they found a nodule, not attached to the surrounding walls, and of which its surface, as also the surface of the cavity sides, presented a fibrous aspect. Doubtless, this appearance was due to the rubbing of the surfaces against each other during the rolling of the bar.

The general composition of the bar and that of the walls of the cavity were in agreement and showed on analysis to contain C. 0.41, Si. 0.08, Mn. 0.57, P. 0.09, S. 0.02 and Cu. 0.035 per cent., whilst the nodule gave the following: C. 0.065, Si. 0.02, Mn. 0.57, S. 0.03, and Cu. 0.03 per cent. The bar, when etched with copper ammonium chloride, showed normal bands of ferrite and pearlite at the edge and large bands of ferrite with slag inclusions in the centre, whilst the nodule only presented ferrite grains. It was put forward that a small piece of mild steel had fallen into the mould and had never been melted and assimilated by the metal.

A hollow forging made from a rolled bar showed line cracks of the stepped variety, with numerous fine cracks on the surface. Quantities of inclusions in layers parallel to the surface were found, but no masses of either phosphorus or sulphur were encountered in the vicinity of the crack. It is thought that the conditions are brought about by superficial blowholes.

Line cracks, resulting from a lack of continuity of the metal, are due to ingot defects, which may take the form of (1) contractions due to segregation, (2) inclusions of foreign bodies, (3) slag inclusions, (4) blowholes.

Others, quite frequent, are more difficult of explanation. For instance, it may happen that on pressing out a hollow body, that the apex of the portion receiving the pressure may become detached, owing to an adherence fault due to segregation bands or slag inclusions. It is well known that the tensile strength and elongation in rolled steel are less transversely than when taken from a test piece parallel to the direction of rolling, and this difference can be very great when line cracks are present. Schultz and Goebel observed the stepped line formation in a thick-walled pierced tube, which microscopically showed large quantities of slag inclusions and numerous longitudinal high phosphorus bands, but, in spite of this, gave excellent tests when taken in the direction of rolling. The tests taken at right angles were naturally lower. Those taken along the length of the tube showed 50 tons per sq. in. maximum stress, and 39 tons yield point, associated with an 18 per cent. elongation.

A roll Siemens steel bar showed at its centre an extensive zone of line cracks surrounded by normal grains. No segregation was apparent, but at the centre large wide bands of ferrite could be seen, and also at the edges short narrow bands of ferrite were distinguishable. Heat treatment tests showed that in rolled steel containing very fine slag inclusions, very few segregation lines and large ferrite bands, with the characteristic tendency to line cracks, these can be suppressed by (*a*) reheating to 850 deg. Cent., which increases the grain size of the ferrite bands, (*b*) water quenching; subsequent heat treatment does not bring about the reappearance of the cracks, (*c*) heating to 600 deg. C., which does not modify the general structure.

XUM

From these tests, it appears that line cracks do not depend either upon slag inclusions, lines of segregation, or ferrite bands.

Other tests made on a similar bar which contained a few more uniformly disposed slag inclusions, a little less of the fine segregation lines and parallel lines of ferrite.

Reheating to 900 deg. C. did not eliminate the line cracks, whilst ferrite lines were developed, and quenching brought about the reappearance of the cracks between the grains. This anomaly taken in conjunction with the previous case allows of the statement of the following hypothesis:—Line cracks due to slag inclusions and segregation cannot be eliminated by reheating. If the inclusions and segregation are not important, the line cracks are consequential on the linear structure, and in certain cases they disappear as the linear structure is accentuated or diminished. Probably internal stresses should be considered in such cases.

In every case it appears to be established that, besides line cracks produced from diverse varieties of defects and an unfavourable distribution of the slag inclusions and segregation, they can be produced from other sources which are associated with linear structure and the method of rolling

Experiments on the Time of a Blow.*

The time of impact of two bodies depends upon their shape, physical properties, and velocity, and the study of this problem presents many difficulties. The author describes some experiments made to ascertain the time of impact between a small, hard-steel ball and a plate. The former was suspended by a fine copper wire as a pendulum, and was allowed to strike a plate at the lowest point of its swing. The time was measured by passing through the wire and ball a current which was started and interrupted when the ball struck and rebounded from the plate, the duration of the blow being determined from the swing of a ballistic galvanometer in the circuit, the constant for which was predetermined. The plate, which has polished faces, is held in an insulated holder, and, if of non-conducting material, is tinned upon one face. The weight of the steel balls used ranged from 74 to 16.6 grms. (0.163 to 0.0365 lbs.), and their diameter from 2.5 to 1.5 cm. (0.985 in. to 0.591 in.). For hard materials the time is divided into two periods, t_1 during which the ball comes to rest, and t_2 from rest until it acquires a velocity upon leaving the plate. The coefficient of restitution was obtained by noting the angle of swing on the rebound, from which the velocity at the instant of separation could be determined. This coefficient decreased towards a limit as the striking velocity was increased, and it also increased as the size of the ball was diminished. By means of this coefficient the total time of contact could be divided into t_1 and t_2. For various substances the values of (t_1+t_2) were as follows, for a steel ball of 2.5 cm. (0.985 in.) striking plates made of the materials at velocities up to 160 cm. (5.25 ft.) per sec. :—

Material	Time (t_1+t_2) Seconds.
Cast iron	1.4 to 1.8×10^{-4}
Steel	1.2 ,, 1.5×10^{-4}
Wrought iron	1.5 ,, 1.9×10^{-4}
Ebonite	4.7 ,, 5.5×10^{-4}
Rubber	28.5 ,, 37.0×10^{-4}
Copper	2.3 ,, 2.7×10^{-4}
Aluminium	2.4 ,, 2.6×10^{-4}
Brass	2.5 ,, 3.0×10^{-4}
Tin	1.7 ,, 2.3×10^{-4}
Lead	1.6 ,, 2.5×10^{-4}

The time diminishes with the size of the ball.

The time t_1 was measured for a number of substances, from which the average force of the blow, or $m\ v/t_1$, could be found. For a steel plate this was found to be 0.51×10^{-4} sec., taking the mean value for velocities of 16 cm. (0.63 in.) to 138 cm.

Since the beginning of 1921 changes in the rates of wages in Great Britain reported to the Ministry of Labour have resulted in a net reduction of over £3,550,000 in the weekly wages of 320,000 workpeople.

* Inst. C. E. Foreign Abstracts.

The Refractory Materials of the London Basin.*

By Henry Dewey.

By the London Basin the geologist means that part of the south-east of England which is practically the same as the Thames Basin. It is bounded by two divergent ranges of hills, the Chilterns on the north and the North Downs on the south, and on the east by the coast. Both these ranges consist of chalk, but the dip of the chalk in the Chiltern Hills is generally towards the south whereas in the North Downs it is towards the north. The chalk is covered between these hills by beds of sand, loam and clay, and occasionally with seams of pebbles which are known collectively as the Tertiary and Pleistocene formations.

The chalk supplies very little material of a refractory nature. The bands of flint nodules, however, are used in some potteries; for instance, the rounded black flint pebbles from the coast of Normandy are employed at the Coalport China Works near Bridgnorth.

The foundry-sand which has been dug for many years in the neighbourhood of Erith consists of the more clayey bottom of the Thanet sand. It is an excellent moulding sand, and its presence there in large quantities has been said to have determined the site of Woolwich Arsenal.

The most remarkable deposit of this age is that which occurs at Epsom and Ewell, in Surrey. It consists of loamy sand of a greenish-grey to white tint, and varies in thickness up to 5 ft. In the time of Henry VIII. it was dug for moulding sand for goldsmiths' work, and has been described by several of the old topographers. In recent years refractory wares used at many of the London and other gasworks have been made from this material.

An analysis of NN Fire Earth, supplied by Stone & Company, Limited, Ewell, Surrey, shows the following chemical composition:—Silica, 87.57; alumina, 3.60; oxide of iron, 4.80; lime, 0.74; magnesia, 0.41; potash, 0.69; soda, 0.10; water of combination, 2.09—100.00.

Unfortunately this bed of loam is not known to occur elsewhere in the neighbourhood, so that its reserves are limited to a small area. Pipes and roofing tiles and red bricks are made from the plastic clay of the same pits and also from the neighbouring Cheam pits. Some of the Tudor bricks employed in building the now demolished Nonsuch Palace were made at the Ewell kilns, and about a century ago a special type of tile-brick was in demand for building houses to avoid the payment of a brick tax. Several old houses in Ewell still exist where these tile-bricks can be seen.

A chemical examination of the plastic clay from Coldash Common, near Newbury, Berkshire, was made by Prof. Voelcker.

It gave a general analysis of 54.64 per cent. of sand and 25.46 of pure clay, but detailed it showed:—Silica, 73.736; soluble oxides of iron and alumina 5.031, insoluble 7.107—12.138; lime, 2.980; magnesia, 0.047; potash, 2.077; soda, 0.525; chlorine, a trace; combined water and organic matter, 8.698.

The following analyses were made for the Down Mill Company, of Bracknell clay, and for the Associated Portland Cement Manufacturers (1900), Limited, of clay at Swanscombe, Kent.

Analyses of London clay from Swanscombe Wood, Kent:—

Silica		30.84	28.74
Alumina		13.72	14.91
Ferric oxide		6.30	5.81
Lime		1.06	1.08
Magnesia		2.80	2.59
Sulphuric anhydride		0.49	0.67
Loss on ignition		6.88	5.86
Insoluble residue		36.52	39.26
The insoluble matter consists of:—			
Quartz		22.02	22.70
Silica (Felspar)		9.88	11.22
Alumina (Felspar)		2.80	3.18
Soda (Felspar)		1.70	1.93
TiO_2		0.12	0.23

Several of the formations supply sand which is used in the manufacture of glass, but this subject has already been fully dealt with by Professor P. G. H. Boswell, so is omitted from the above account of refractory materials.

* Extracted from a Paper read at the Autumn Meeting of the Ceramic Society.

Tar-Oil-Fired Furnaces.*

By Oberingenieur Kuenscher.

Coal-tar oil is freely used in Germany instead of petroleum fuel oil, which is too high in price owing to the low rate of exchange. The special advantage of firing non-ferrous metal furnaces with coal-tar oil is that with perfect combustion the excess of air is reduced to a minimum. Oxygen and sulphur are the metal founder's worst enemies. With oil-firing properly employed the melting loss is unquestionably 2 per cent. less than with coke-firing. It is, of course, presumed that a good oil, not containing dirt and water, is used. Ordinary coal-tar oil should not contain more than 1 per cent. of water and only 0.2 per

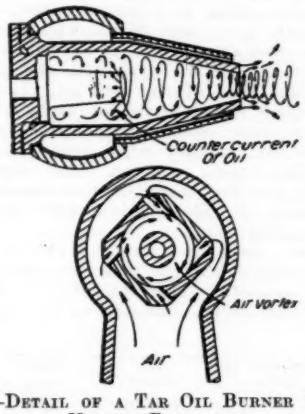

Fig. 1.—Detail of a Tar Oil Burner Built on Vortex Principle.

cent. of other impurities. Coal-tar oil of good quality now costs more than twice as much as coke, but to obtain a comparative estimate of costs, however, it is not enough to compare the cost of fuels. Account must be taken, in the first place, of the small melting loss, as well as of the other technical and economic advantages derived from oil-firing.

A good mixture of the fuel with the air is essential for perfect combustion. Fig. 1 shows an approved burner on the vortex principle. This vortex is produced by the tangential entry of the air into the mixing chamber. The issuing oil jets are caught by the air and are atomised and mixed by the rotary motion into a fine vapour.

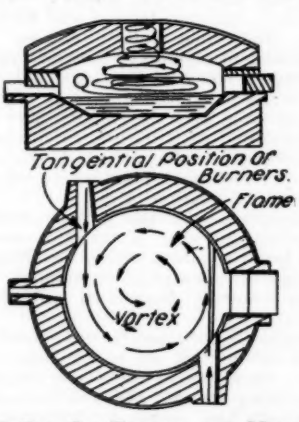

Fig. 2.—A Tar Oil Furnace for Melting Non-ferrous Metals Without Crucibles.

This atomisation within the burner causes a good burning mixture to issue from the orifice of the burner. Particles of oil, which rush outward under the influence of expansion, are forced against the cone of the flame by the added air which escapes in annular form. The rectilinear velocity of the air is greatly diminished by the vortex, and the ignition point is thus transferred to close in front of the orifice of the nozzle. By this means a fan-shaped flame of moderate power is obtained. The burner is worked by blast air with a pressure of 16 to 24-in. water column.

* Extracted from a translation, by "The Foundry," of a Paper read before the German Non-ferrous Metal Founders' Association.

Fig. 3 shows a stationary crucible furnace in which the vortex principle is employed. The tangential entry of the burner and the spiral upward movement of the heating gases are clearly shown. Stationary melting furnaces are made for a crucible capacity of 66 to 330 lbs., and tilting furnaces for a crucible capacity of 220 to 1,760 lbs. The duration of melting is, according to the size of the crucible, 20 to 45 minutes for stationary furnaces and 35 to 110 for tilting furnaces. The oil consumption fluctuates between 8 and 12 per cent. of the yield.

While with crucible furnaces the heating of the bath is effected indirectly, in melting furnaces without crucibles the operation of the flame is direct. It is only with this method of working that the chemical advantages of oil-firing can be

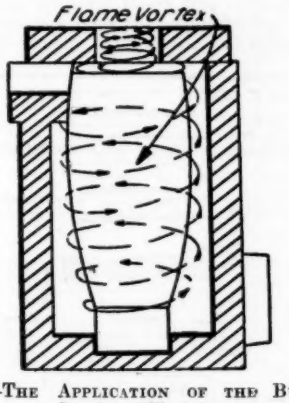

Fig. 3.—The Application of the Burner to Crucible Melting.

fully obtained. Fig. 2 is a diagrammatic representation of the heating of a furnace without crucible utilising a spiral movement of the heating gases. This method is distinguished by a flame which circles over the metal bath. The burners are so arranged that a "circular vortex" which returns within itself is produced over the metal bath, and this effects a good combustion of the heating gases. A fire ring consisting of heating gases is formed at the outer circumference of the surface of the metal bath, and the movement of these gases is retarded by centrifugal force. This retardation effects a perfect combination of the carbon particles with the oxygen of the combustion air, and a neutralisation of the flame is produced. The heating gases are set in motion only by the introduction of further quantities of heating gas toward the centre of the furnace, and they escape under pressure through the outlet.

For melting non-ferrous metals it is desirable that the furnace should be well heated, so that the melting hearth and the masonry are thoroughly hot. The charge is inserted gradually in order to avoid cooling the furnace too much, and covering materials, such as charcoal, salt, etc., are employed to protect the surface of the metal bath. Furnaces without crucibles are built up to a capacity of 2 tons. The duration of melting is, according to size, 40 to 130 minutes, and the oil consumption 5 to 8 per cent. of the weight of metal melted, according to the nature of the alloy.

DANISH RAILWAY REQUIREMENTS.—The Danish State Railways has invited tenders for the supply and delivery, before April 1, 1922, of iron bars and plates in a variety of dimensions. Tenders, which should be marked "Tilbud paa Levering af Jern," will be received at Maskinafdelingens Kontor, Trommesalen No. 5, Third Floor, Copenhagen, B., up to October 27. Tenders are to be accompanied by a price list of the tendering firm for goods in stock valid from the date of tender up to June 30, 1922. A copy of the specification, conditions of tender, and tender form (in Danish) may be inspected by United Kingdom manufacturers and exporters on application to Room 50A, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Two additional copies are also available for loan in order of application to firms in the Provinces who are unable to inspect the documents in London.

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The New "Ford" Foundry.*

The Ford Motor Company is responsible for the production of over 1,000,000 cars a year, and the output of their shops has averaged 4,000 cars a day for over two years, and recently this has been increased to 4,500. Some departments operate eight hours a day, some sixteen hours, and a few on twenty-four hours' schedule. If the entire plant were regarded as working twenty-four hours a day, or 1,440 minutes, it readily would be apparent that a car is completed in the almost unbelievable time of 0.32 minute. To express it another way, the cars are rolled out of the factory at the rate of three a minute twenty-four hours a day, 300 days a year. This tremendous output has been accomplished at the Highland Park plant of the company, and would seem to be the summit of human achievement, for such a stupendous production seems to be something impossible to maintain either in manufacture or distribution. But an entirely new plant, including a foundry, is almost completed at River Rouge on the eastern outskirts of Detroit, in which it is proposed to manufacture the castings for 8,000 cars a day, in addition to a large tonnage of castings for tractors. Furthermore, as indicating the scope of the company's ambition, the plans provide for expansion even of this mammoth plant to twice its capacity.

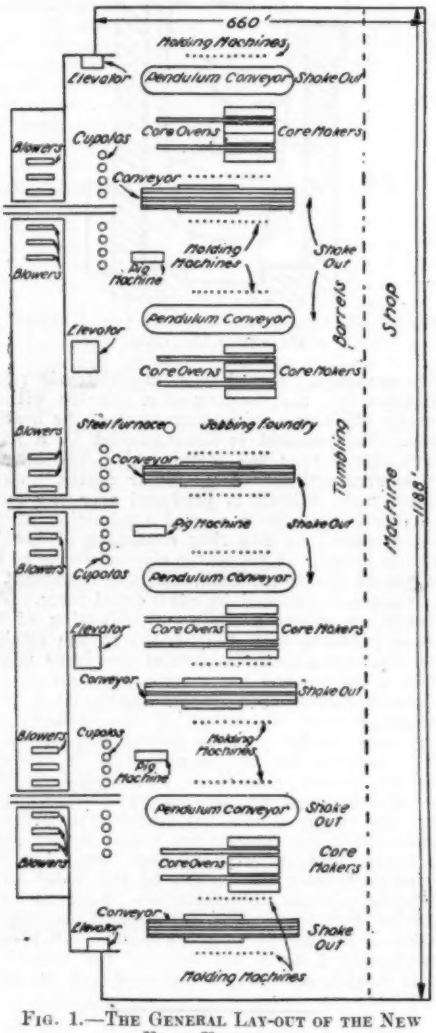

Fig. 1.—The General Lay-out of the New Ford Foundries.

The River Rouge plant, which eventually will comprise eight 450-ton blast furnaces, a sufficient number of batteries of by-product coke ovens to supply them with coke, steel-making furnaces, rolling mills, foundries, machine shops and assembling plants, is being placed in operation as fast as the different units are completed. A number of coke ovens, together with the necessary building and apparatus for the recovery of the by-products already are in operation. Two blast furnaces have been completed, and one of them has been making iron for some time. A certain amount of the iron is taken directly to the foundry, where it is mixed with the cupola iron; the remainder is taken to a modern pig-casting machine.

The foundry building proper, 1,188 ft. by 660 ft., required 8,000 tons of structural steel. A continuous steel sash encircles two sides and one end. The other end is built of brick with four large doors and several windows. It is divided into eighteen bays by columns spaced on 66-ft. centres both ways, and 27 ft. high in the clear under the roof trusses. It is lighted by eighteen lantern frames on the roof, with the gable ends on the long sides of the foundry. Incandescent lights furnish illumination for night work. The inside equipment, comprising elevators, conveyors, etc., consumed another 8,000 tons of structural steel. The cupola building, four stories high, which adjoins and parallels the foundry building all along one side, required 9,000 tons of steel in its construction.

The floor, made up of wood blocks laid on concrete, is divided into two main sections by a wide gangway extending longitudinally in the centre from one end of the building to the other. The floor on one side of the gangway is devoted to shaking out, cleaning, testing and dispatching the castings. The other side is divided into eight units devoted to moulding, core making and pouring castings. The sand for the moulders and coremakers is reconditioned in a set of mixers and hoppers situated over the gangway and taken back to the moulding machines and coremakers' benches by an overhead conveyor which discharges into hoppers provided with hand-controlled gates over each workman's station.

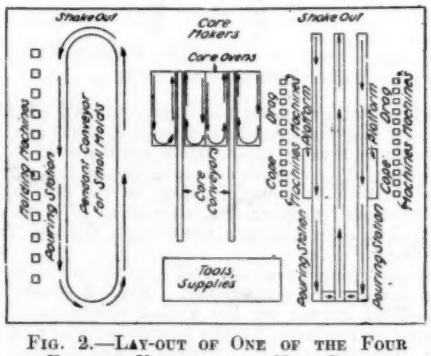

Fig. 2.—Lay-out of One of the Four Foundry Units of the New Plant.

The equipment for the entire foundry is not yet installed, and some of the later conveyors will differ in detail to meet peculiar conditions incident to the class of castings to be handled, but in the main the following description will cover each of the units.

The entire foundry may be considered as a unit, inasmuch as through an elastic monorail system, iron may be delivered from any cupola to any of the pouring stands, and also because the iron entering into the charge is delivered on a continuous charging floor, and may be deflected to any of the cupolas. Still, in practice, the foundry is divided into a number of self-contained units which may function individually. Similarly, although four batteries of core ovens are provided, each battery designed to serve two moulding units, in an emergency the cores may be conveyed to any point in the foundry. From the foregoing it will be apparent readily that although the foundry is under one roof, it really comprises eight fully-equipped foundries, each one operating on a special line of castings. For the same reason a detailed description of one unit may be regarded as typical of them all.

With the exception of the moulding machines, motors and possibly some minor pieces of equip-

* From the "Iron Trade Review."

ment, the Ford Company, designed, constructed and installed all the conveyors and sand-handling apparatus to meet its special requirements. A considerable part of the equipment is modelled on that used in the Highland Park plant, and the changes in the remainder are in line with the company's policy of ever seeking means to increase production. The dominant aim and object of the Ford organisation is increased output.

Core Sand.

At present the new sand for the cores is hauled in from the yard in a dumping pan drawn by a gasoline truck. Eventually it is proposed to bring it in on a belt conveyor. From the pan it is dumped through a grating in the floor of the gangway. A bucket elevator conveys it to a hopper located above a mezzanine floor which extends over the coremaker's stations at one side of the gangway and over the batteries of tumbling barrels on the other side. The floor extending over the tumbling barrels is utilised for knocking the cores out of the castings. It is provided with gratings through which the spent core-sand drops on to a belt conveyer, which discharges into a breaker and magnetic separator which removes the scrap from the sand. From the magnetic separator the sand is taken by an elevator to a hopper adjoining that in which the new stand is stored. Both hoppers are provided with bottom-discharge spouts

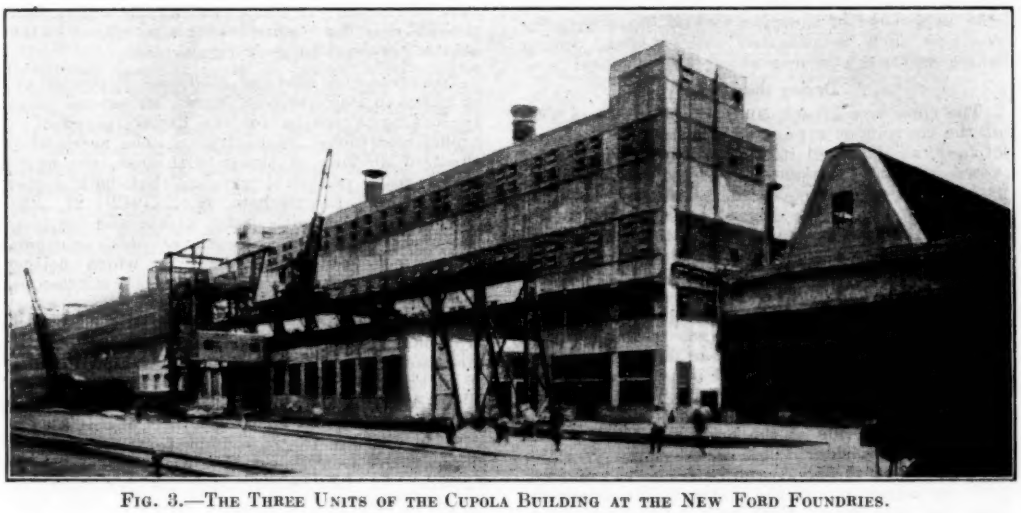

Fig. 3.—The Three Units of the Cupola Building at the New Ford Foundries.

equipped with hand-operated gates through which the requisite amount is measured into a box and then, together with the necessary amount of binder is conveyed to a mixing machine of the worm type. Water is added at this point, and, after a predetermined number of revolutions, the prepared sand is discharged into a dumping pan, which is hauled by hand to the openings of the spouts leading to the coremaker's stations and discharged.

The water-jacket cores, port cores, and valve housings are made of all new sand bonded with an oil binder made to special formulæ for the Ford Company. The large body cores carrying the barrels are made from a mixture of old and new sand in the proportion of approximately three to one depending on local conditions, such as the amount of old sand available, and bonded with a pitch compound made to Ford specifications. The sand is mixed in the proportion of 1½ parts of compound to 20 parts of sand. It is claimed that a higher percentage of sand would make satisfactory cores under ordinary circumstances, but on account of local conditions, breaking-in new men, rough usage, etc., it is the part of economy to use more binder.

The well-known Ford plan of intensive production by assigning one job to one man is exemplified in a striking manner in the core-room, a number of circular steel plates mounted about waist high under the sand chutes are employed as benches on which to make the greater part of the cores. Usually five workmen are stationed at each table. The first man places a certain amount of sand in the box, he then pushes the box to the second, who sets the wire and passes the box to the third, who places the remainder of sand in the box and sets the vent wires. The fourth rams it, and passes it to the fifth, who removes the vent wires and turns the core into a dryer. In this manner a constant stream of cores is kept moving around the table. Another workman does nothing but lift the finished cores off the table and place them on a pendulum conveyor, which takes them to a revolving stand at which a workman stationed with a spray nozzle coats them with blacking. An additional workman, standing by the blacking stand lifts the core and places it on a suspended core rack, which travels down one side of the oven and up the other. When the cores emerge they are perfectly dry, and are lifted off and placed on a wooden-top belt conveyor operating between two ovens. This conveyor delivers the cores to the assembling and inspection department, which occupies the entire space between two moulding units. From this point the cores are conveyed by spring barrows to the men who place them in the moulds.

Some of the valve-housing cores are made on tables provided with vibrator attachments, and it is interesting to note that they weigh several ounces less than cores produced on benches that are not equipped in this manner. Each gang of five men makes 675 valve-housing cores a day, a similar gang of four men makes 675 water-jacket cores. Men working individually make the port cores at the rate of 495 a day, and others make the large body cores at the rate of 165 a day.

The Body Core.

The body core is made in two parts with two barrels attached to each section. This division has been adopted to facilitate making, drying and placing the core in the mould. The only reinforcement used in the core consists of a length of 1¾-in. steel pipe extending through the centre of each barrel from end to end. The pipe is freely perforated with ¼-in. holes, and that is all the venting the core receives. The pipe arbours for the body cores are brought down from the knock-out floor on trucks, and one man does nothing but dip them in a vat of thin paste. A second man distributes them to the workman ramming the body cores.

The core-box, made of cast-iron, accurately machined and finished, is made up of a base and four loose sides. The sides are assembled on the base barrel end down, and are held in place by four screw clamps. The operator sets the two pipe arbours, which automatically centre themselves in the base. He then releases the gate in the sand chute, and allows a sufficient quantity of sand to flow into the box to fill it to the top. He uses a rammer consisting of a narrow eliptical ring attached by two uprights to a handle, to ram the sand around the arbours. He shovels enough sand off the floor to complete the operation, and butts it off with a short hand rammer. He uses a short steel straight-edge to scrape the surface flush, and then removes a ¼-in. steel rod from

the centre of each arbour. These rods are placed in the pipes before any sand is introduced into the box. The lower ends of the pipes are partly closed, and the rods serve the double purpose of helping to centre the pipes and ensure a clear vent through the holes in the ends. The upper ends of the pipes are open and a certain amount of sand falls into them during the ramming operation. After the core has been rammed, the box is laid on its side. Then a small iron plate is placed against the large end and the box is inverted from its original position. At this stage the clamps are removed, and the side plates are taken away one at a time and re-assembled on the ramming stand for another core. A second workman inserts the points of a piece of wire bent in the shape of a U into the openings in the ends of the pipe arbours to prevent the barrels from sagging out of shape while the core is green. This job requires keen judgment, for if the wire pinches tightly it will pull the barrels together, while if it is loose the barrels will sag apart. The holes in the ends of the barrels are not machined, and therefore are not an absolutely uniform distance apart, hence the workman is compelled to adjust the wires by the sense of touch.

The coremaker who inserts the wires also tools any minor irregularities on the core, and then with a pair of special hand clips places it on the conveyor which takes it to the blacking stand. The upper end of the pipe section supporting the conveyor shelf is provided with a spiral spring which minimises vibration on the journey.

Drying the Cores.

The core ovens, each 50 ft. by 13 ft. 6 in. are of the continuous type, and are built in batteries of four, as indicated in Figs. 1 and 2. It will be noted that the two outside ovens are separated from the two in the centre by narrow passages. A tunnel under the floor between the ovens houses the gas mains, while the continuous type of conveyor shown is above the floor and serves to convey the dried cores to the storage and inspection department. The ovens are heated by coke-oven gas. Air under pressure is introduced to the gas mains through a suitable mixing mechanism at the back of the central ovens. Two 6-in. gas mains are laid in each tunnel, and these in turn feed a number of 3-in. burners pierced with ½-in. holes in a straight line on the top side of the burners. The burners extending from side to side of the ovens are laid 2 ft. apart on the floor, and each one is provided with an adjusting valve at the point where it joins the feed pipe. Each main also is provided with a shut-off valve, and by an intelligent manipulation of these various valves the temperature may be controlled to a nicety. A recording pyrometer attached to each oven keeps the oven tender posted on firing conditions. It is claimed that after the valves have been adjusted the ovens will run uniformly for hours.

Core ovens of the continuous type are provided with cages suspended from an overhead trolley. Each cage makes a complete revolution of the ovens, in which 1,500 large cores are dried in two hours, and in the ovens in which 2,000 smaller cores are dried in one hour. To prevent any loss of heat through the openings in the end of the oven where the cages enter and come out, each cage is provided at each end with a plate the full height and width of the opening. The entrance and exit of each oven is built in the shape of a short vestibule, and ,consequently, each core cage effectively fills the opening on its way through, either into or out of the oven. Suction fans draw the smoke and steam out of the ovens and discharge into suitable stacks leading through the roof.

(To be continued.)

MR. P. A. HILLHOUSE, naval architect to the Fairfield Shipbuilding and Engineering Company, Limited, was, on Tuesday, appointed to the Chair of Naval Architecture and Marine Engineering in the Glasgow University in succession to Prof. Sir John H. Biles retired. Mr. Wm. J. Goudie, lecturer on heat engines in the University, was appointed to the James Watt Chair in the theory and practice of heat engines. An appointment to the James Watt Chair of electrical engineering will be made at an early date.

Principles of Alloying to Resist Corrosion.*

By O. P. WATTS.

It is easy to make a corrosion-resisting alloy from two metals which are themselves highly resistant, such as the noble metals, but the real problem is to take a cheap metal and add to it a small or a moderate amount of some other element that will render the resulting alloy resistant. Theoretical considerations would lead to the conclusion that of all the possible forms in which two elements alloy, the chemical compound will prove most resistant to attack. The truth of this is seen in the work of Moissan in the making of new silicides and borides. He formed the desired compound in an excess of metal, which by boiling with acids was dissolved, leaving behind the chemical compound. But these same experiments show that it will not do to have both free metal and compound present in the alloy if it is to resist corrosion; the alloy must be all compound. For many uses of corrosion-resisting materials, malleability, or at least freedom from marked brittleness is a necessity; but the brittleness of all ordinary chemical compounds is one of their most general characteristics, and the compounds formed between two metals are no exception to the universality of this rule. The use of alloys which are wholly compounds must be confined to places where brittleness is not fatal to their employment.

The protective effect of additions of copper and of nickel to iron has been known for several years. In seeking a reason for the protective effect of copper and nickel, in contrast to the accelerative effect of alloying platinum with iron, the writer found from published articles that both copper (Trans. Am. Electrochem. Soc. (1912), 21, 358) and nickel form with iron, within the limits in which their addition is beneficial, solid solutions, *i.e.*, homogeneous substances in which neither metal can be detected by the microscope. Duriron, tantiron, etc., are iron-silicon alloys which contain about 15 per cent. of silicon. These are solid solutions and exhibit remarkable resistance to corrosion. Monel metal, the natural alloy of nickel and copper, has found extensive application on account of its unusual resistance to corrosion by various chemicals; this also is a solid solution. One of the most important of the recent non-corrosive iron alloys is stainless steel, which is an alloy of iron with about 13 per cent. of chromium and 0.3 per cent. carbon. Tammann and Trietsche (Zeit. anorg. Chem., 55, 402) state that iron and chromium form a series of solid solutions.

A consideration of the five corrosion-resisting alloys mentioned above leads to the conclusion that to increase the resistance to corrosion of any metal there should be alloyed with it another metal which is more resistant to corrosion, and which forms a solid solution with the metal whose resistance to corrosion it is desired to enhance.

That only a trace of the alloying element can produce remarkable effects is shown by "copper-steel." Two pieces, each 5 cm. square and of the same thickness, one of ordinary steel and the other containing about 0.25 per cent. of copper, were placed in 200 cc. of normal sulphuric acid for 20 hours at 30 deg. C. The former lost 5.507 gr. and was nearly all dissolved, but the latter lost only 0.063 gr. in weight.

A test which the writer has found very useful for quickly distinguishing highly resistant alloys of iron is immersion for a couple of minutes in a strong and slightly acidified solution of copper sulphate. Only the most resistant alloys, such as duriron and stainless steel, fail to acquire a deposit of copper.

If an alloy must be ductile it is advisable to experiment with metals more resistant to corrosion than the basic metal which he proposes to use, *i.e.*, metals below it in the electro-chemical series in those electrolytes against whose attacks he desires it to be immune. If brittleness is no detriment, he can hardly do better for resistance to acid solutions than to test various silicides of the metals.

* Extracted from the "Brass World."

Some Details of Foundry Management.*

By E. Carey Hill.

It will be generally agreed that the one common objective underlying all systems of foundry management, whether ferrous or non-ferrous, is the maximum output of good castings of consistently high standard, fully conforming to their various specifications as regards analyses and physical qualities. But, this maximum output must not be attained at the expense of a serious increase in the percentage of scrap, which would, of course, neutralise the advantages gained by increased production. The percentage of rejected castings or "wasters" from all causes must be as small as possible, and the number to be rejected by a customer after delivery should be negligible, or, preferably, none at all.

This desirable state of affairs can only be attained by a continuous anti-waste campaign, conducted according to pre-arranged plan, and forming part of the regular foundry routine. It is intended to deal only with certain details of works organisation and the methods which the writer has developed to secure the desired result in an aluminium foundry.

In aluminium founding the production of successful castings hangs on threads so slender and numerous that the greatest attention to detail is imperative. It is of primary importance that the aluminium casting starts its career in the right direction, as an error at this stage may cause its ultimate rejection, whatever good qualities it may otherwise possess, and however unblemished its individual appearance may be. If it is constitutionally out of order the only remedy lies in avoiding similar symptoms in its successors, which leads to the important question of the preparation of furnace charges, as controlling the properties of the materials of which the casting is to be composed.

Furnace Charges.

It is in the nature of things for furnace charges to vary considerably in their composition, owing to the multiplicity of alloys which are in regular use in the foundry. In our case, we have, first of all, our standard alloy, containing a small amount of copper, and a much larger quantity of zinc. This alloy is used for the general run of castings and is admirably suited for the purpose. Then there are various other alloys, more or less standard, which are particularly adapted for special work, such as the manufacture of pistons and motor radiator tanks. These alloys contain aluminium and copper only, a harder and more closely-grained metal being required. Again, orders are frequently received—especially for castings destined for aircraft work—which specify certain stringent Government, Admiralty or other specifications that must be rigidly observed. Frequent examples are the Air Board Specifications L5, L8, and 2L11.

Finally, alloys containing the rarer constituents, such as nickel, magnesium and manganese are sometimes called for—magnesium especially being in increasing demand as an important constituent, not only in Mg-Al alloys, but also in a recently-tried new piston alloy containing also copper and nickel.

It will, therefore, be readily seen, that alloys varying so much in their composition, necessitate certain precautions to avoid incorrect mixtures and the intermixing of "remelts." It is desirable at this juncture that our meaning of the term "remelt" should be interpreted. Remelt consists essentially of runners and risers, which are cut off by the fettlers. Aluminium is a metal that contracts appreciably during solidification, and this contraction calls for liberal runners and feeders if a sound casting is to be produced. A small feeder is generally of very little use; in fact, it may be acutely detrimental to the casting, inasmuch as the desired result may be reversed, the casting feeding the riser instead of the riser feeding the casting. Consequently, it often happens that the weight of the gates and feeders often equals or exceeds the weight of the casting itself.

When the castings are fettled, it naturally follows that the gates and feeders cut off accumulate very rapidly, and have to be again remelted. Obviously, the risers and runners consist of exactly the same alloy as the castings, and from which they have been detached, and can, therefore, be used as portions of successive charges of alloys of the same composition.

Remelt also consists, in a much lesser degree, of castings which are cut up and remelted, because, for some reason or other, they have failed to

FURNACE CHARGE.

Alloy No. 98E Date 1st /Sept/21

Metal No.	Weight of Charge 50 lbs			80 lbs			220 lbs			300 lbs		
	cwts.	qrs.	lbs. ozs.	cwts.	qrs.	lbs. ozs.	cwts.	qrs.	lbs. ozs.	cwts.	qrs.	lbs. ozs.
21 Ing			20 4		1	4 7		3	5 2	1	0	9 8
56 E			1 6			2 3			6 0			8 4
18a.E			3 6			5 6			14 14			20 4
Remelt			25 0		1	12 0		3	26 0	1	1	10 0
Total		1	22 0		2	24 0	1	3	24 0	2	2	20 0

Fig. 1.—The Front of a Filled-in Furnace Charge Sheet.

pass the inspector. As the composition of the remelt obviously is identical with the castings of which it originally formed a part, it is of great importance to keep the remelt of each particular alloy separate.

Each alloy is allotted a number, by which it is generally known throughout the works. For example, our standard alloy is No. 97; the alloy commonly used for radiators is No. 55, and one of our standard piston alloys is No. 92. Further, every constituent of each alloy has its own number, *e.g.*, Cu is added in the form of a 50/50 Cu.-Al. alloy, known as No. 56. Pure aluminium ingots are No. 21 and zinc is No. 18.

Each charge is carefully worked out, and is typed on a furnace charge sheet, as shown Fig. I. Only one alloy, of course, is represented by each card, which is made out in duplicate, one copy

DATE ISSUED	DATE WITHDRAWN
28. 6. 20	28. 6. 20
6. 7. 20	14. 7. 20.
21. 8. 20	14. 12. 20
16. 12. 20	21. 7. 21.
1. 9. 21.	1. 9. 21.
REMELT 50%	

Fig. 2.—The Back of a Filled-in Furnace Charge Sheet.

being issued to the man responsible for weighing out the charges, and the other copy being retained in the office as a record. Four different weights of charges are made out on the card, viz., 50, 80, 220 and 300 lbs. The normal charge is 300 lbs., but the smaller charges are issued when required and melted in furnaces of approximately corresponding capacities.

It should further be explained that for each alloy three separate cards are made out in duplicate, the final composition of the alloy being the same in each case. The variable factor is the percentage of remelt, and it is always our object to keep the stock of "remelt" for each alloy at a more or less constant level in order to prevent it accumulating too much or vanishing altogether The quantity of "remelt" which enters the metal mixing room—that is, where the charges are pre-

* This Paper was given as the Presidential Address before the Coventry Branch of the Institution of British Foundrymen on September 1, 1921.

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pared—from the fettling shop and foundry varies considerably, owing principally to the variation in the size and number of gates and feeders on different types of work in progress at various times, and due also to a less extent to the variation in the quantity of defective castings which must be melted down. The weight of gates and feeders depends chiefly on the size of the castings being made in the shops. Heavy castings require substantial feeding; smaller castings have smaller feeders and castings with pronounced variations in thickness usually require more feeding than castings of uniform thickness; hence the variation in the bulk weight of "remelt" available. To counteract this variation, when it occurs, the percentage of remelt in the charges is altered as required, and furnace charge cards are already made out containing three different proportions of remelt, so that no time is lost in making out a new card, when more or less remelt is required, as the case may be. The remelt is kept in the metal mixing room, and each day a requisition is made out by the metal mixer to the metal stores for the estimated amount of virgin metals or special alloys required for the day's output.

Thus, the furnace charge sheets serve a double purpose: They provide the metal mixer with the exact weights of the various metals in each alloy, and they also, almost automatically, regulate the stocks of remelt.

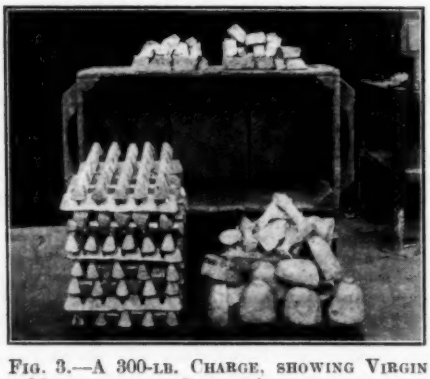

Fig. 3.—A 300-lb. Charge, showing Virgin Metals and "Remelt," together with its Containing Box.

But the correct weighing out of the consituents in accordance with the figures on the charge cards does not necessarily, of itself, ensure that the foundry manager's desideratum—that is, the uniform analytical composition of alloys, is always being realised. It is highly important that the remelt does not get mixed up, as might quite easily happen, with the remelt of another alloy, which might be of totally different analysis.

It would be a serious matter if an aero-engine piston was found upon analysis, after it had failed in service, to have contained 5 per cent. too little copper, and 5 per cent. more zinc than it ought to have—which, as far as the zinc is concerned, is probably nil. This would result if the remelt of standard alloy No. 97, for example, had been confused with the piston alloy remelt No. 92.

There, however, the problem is not quite so difficult in practice as it might appear to be. The sawyer, who cuts off the runners and risers, has his boxes for the various alloys plainly marked with their respective numbers, and he gets to know through experience from what alloy the castings he handles are made. Generally speaking, the great majority of gates travel the way they should go, and find themselves ultimately in the right box. If the sawyer is uncertain of the alloy, the information is easily obtained on the lines just detailed.

With respect to remelt from the foundry, that is, runners of feeders broken off hot, in extracting the castings, or spilt metal, this is collected by the moulder and put in bins provided for the purpose, each bin being plainly marked with its alloy number; and, of course, each moulder knows from his instruction card the number of the alloy with which he is working.

Adequate attention to the weighing out and distribution of the constituent alloys and remelts which make the charge, should ensure that each alloy is maintained well within the limits of its specification. In foundries, where a quantity of scrap metal of unknown and probably varied analysis is bought from outside sources, it is practically impossible to maintain any uniform specification, and obviously, no guarantee of analysis or physical qualities could be given.

If any alloys must be purchased from extraneous sources for any reason, they must be of stable composition, and the guarantee of the suppliers should be consistently checked by the taking of independent analyses. Scrap metal bought indiscriminately is really within the province of the metal refiner and not of the aluminium founder; for the latter, generally, has not the necessary facilities for melting down large quantities of scrap in bulk—a process that is imperative, in order that an alloy of uniform composition may be obtained. It is true that an analysis of the metal made from melting scrap only, in bulk, if well mixed during melting, would give the founder something more definite, at least, to work from, in making up his furnace charges, but the probable presence of excessive impurities would greatly detract from the physical qualities of the final alloy in the casting. We now may justifiably assume that the charge weighed out in the metal mixing room is correct, and it is conveyed in boxes, shown in Fig. 3, of adequate size corresponding to the charge, to the furnace man, who assumes responsibility for it.

Test Bars.

Between the filling with molten metal of the carrying ladle or crucible, and its subsequent pouring into the mould test pieces have to be cast. This may have a vital effect on the history of the casting into which that metal will shortly be transformed. These bars, when pulled, show the tensile strength and elongation of the alloy, and the figures thus attained are generally of great interest to the designer of the engines or structures in which the castings represented by the bar are ultimately intended to play their part. During the war, especially, great stress was laid on the physical qualities of all alloys, especially those used in aeroplane work, where weight was cut down to a minimum and factors of safety reduced to fine limits.

Progress in the direction of commercial aviation will, inevitably, be accompanied by a demand for materials of the very highest efficiency, and there is no doubt that metallurgists and founders between them will have to produce alloys of very high and uniform qualities. It is admittedly difficult to reproduce all the complex stresses, that aluminium castings have to undergo during service, in a simple test that has to be carried out in a few hours, or, at most, in a few days. The time factor has to be eliminated practically altogether, and, consequently, some stress has to be enormously increased in order to produce a sign of strain in a reasonable time. The repeated impact test is an example of this. Test bars will be demanded both now and in the future, so that it may be to our advantage to consider in greater detail the question of making test bars in the foundry.

The first question to be decided is, when and when not to take test bars? This depends almost entirely on the terms on which orders are accepted, and several alternative courses may be adopted:—

1. It was during the war, as we all have either the fortune or misfortune to know, the general rule with Government contracts, as regards aeroplane castings particularly, to insist on all castings being inspected and passed before they left the works by an A.I.D. Inspector. This official not only examined the castings, but selected representative test-bars, and held the castings in quarantine till the physical reports were received. If the result was satisfactory the castings were released, if not, a duplicate bar had to be tested. It may be stated here that two bars were always cast against this contingency. If the second bar went down, all the castings represented were rejected.

2. A second method is to send a bar to the customer with each agreed number of castings. The castings are stamped with the number of the bar, and a duplicate bar is kept by us in reserve.

3. A third method is to make the tests in our own laboratory, and send a certified report to the customer.

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4. The last method is that our general guarantee of the alloy be accepted, neither test bars nor copies of physical results being sent to the customer. In this case it is decided by us whether tests are taken or not, and our procedure, in order to safeguard our customers and ourselves, is to take bars and test them at frequent and irregular intervals.

That there is more in so outwardly simple a process as the casting of test-bars than meets the eye is undoubtedly true, for the foundry manager sometimes finds himself confronted with the most curious anomalies. It has been found that two test-bars, cast one immediately after the other from the same pot of metal, behave in a most inconsistent manner when tested. One may give a tensile strength of 13 tons per sq. in., while the other gives a paltry 7. The alloy in each is

FIG. 4.—POURING A TEST-BAR IN A CHILL-MOULD.

undoubtedly the same, the pouring temperature must be substantially the same, both are machined to within identical limits, and are pulled in the same testing machine. The only possible explanation, provided that the metal is clean and free from blowholes, is that one bar is correctly poured whilst the other is not.

The test-piece is a rod, 1 in. in diameter, cast in an iron or bronze chill, from 7 in. to 9 in. long, which is either sand-plugged in the bottom or has a metal end. A test-bar cast independently in a chill is accepted as a criterion of the physical qualities of a casting, because the strength of the latter depends on the rate of cooling, and therefore one test-piece cannot possibly represent all parts of the casting. The faster the metal cools in the mould the stronger it becomes, so that chill castings are considerably stronger than sand castings, and thin parts stronger per unit section than thick parts. In sand a ¼-in. plate is 3 or 4 tons per sq. in. stronger than a 2-in. plate. For this reason it was decided by the Air Board originally, during the war, to cast samples to represent the alloy rather than the casting, and this is the function of the test-bar. The previous practice of casting test bars as an integral part of the casting has been discontinued for reasons which we can, in view of the foregoing, easily understand. Not only is the cooling slow and uncontrollable, so as to make it difficult to procure good uniform and comparative results, but in many cases difficulty is experienced in adequately feeding the test-bar, and in deciding which is the least inconvenient, and also the most satisfactory place to attach it to the casting, as it may sometimes be found that the test bar has unintentionally fulfilled the function of a feeder to the part of the casting to which it is attached, and has thereby been deprived of the feed necessary to compensate for its own contraction during solidification.

The chill is well warmed before the metal is poured into it, and it is held at about 45 deg. while being filled, and tipped upright when full. The secret of the successful pouring of a bar is to pour the metal into the chill as slowly as practicable. This operation is illustrated in Fig. 4.

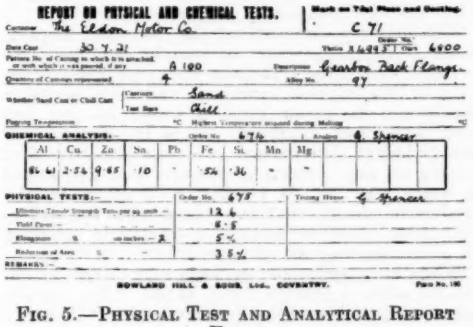
A few simple experiments were recently carried out in our works, illustrating the importance of the rate of pouring. Four bars were cast quickly, and when the moulds were full they were instantaneously turned upside down, which process had, of course, the effect of bleeding the bar. Similarly, four other bars were cast slowly and inverted, and a comparison of the results were made. The quickly poured bars were hollow to within 2½ to 3 in. of the bottom of the mould, though in most cases the shell was correctly formed practically to the top of the bar.

The slowly-poured test-pieces were hollow to within about 2 in. of the top, while their shells were perfect throughout their length. Obviously, the slowly cooled bars had had more time to cool than those poured quickly, but the value of the experiment lies in the fact that it does prove that the quickly poured bar solidifies from the outside inwards and simultaneously throughout its length, while the slowly poured bar solidifies gradually from the bottom upwards. When a bar solidifies throughout its length at practically the same moment, the metal on the top cannot adequately, if at all, feed the lower parts when contraction takes place, with the result that the bar is inclined to be piped, or porous, down the centre. On the other hand, in the slowly poured bar the bottom layer is fed by the layer of molten metal immediately above it. When this layer solidifies, it is in turn fed by the next successive layer, which is formed as the metal is slowly poured into the mould. This process continues till the bar is cast and a sound test-piece results. Incidentally, the slowly cooled bar has also a better exterior finish.

This theory, in our opinion, is the only feasible manner of accounting for the variations in the physical qualities of duplicate bars. If, therefore, so slight an error can cause the ultimate rejection of many valuable castings, for both the duplicate bars might, through carelessness, have been poured too quickly, it follows that careful supervision of the apparently trivial detail will amply justify the trouble taken.

Regarding the internal organisation relative to the recording of physical test results and the retention of duplicate bars, the test-bar record gives the following particulars:—Test-bar and alloy number, description, pattern number, and quantity of castings represented, date and time of day cast, name of moulder and furnaceman, type and number of furnace in which metal was melted, and, finally, the temperature of the metal when cast, if taken. This record is shown in Fig. 5.

When physical test reports and analyses are received from the laboratory, the details of each report are also copied on to the form. Thus there is always available, in a compact and convenient form, a complete history of each test-bar pulled and of each sample analysed. If the sample is of the same cast as the test-bar, and bears, therefore, the same number, then the analysis and physical test results are given on one and the same form, enabling an instant comparison to be made.



REPORT ON PHYSICAL AND CHEMICAL TESTS.

Mark on This Piece and Casting: C 71

Customer: The Eldon Motor Co. Order No.:

Date Cast: 30. 7. 21 Weight: 2 qrs 5 lbs Class: 6900

Pattern No. of Casting on which it is attached, or with which it was poured, if any: A 190 Description: Gearbox Back Flange.

Quantity of Castings represented: 4 Alloy No.: 97

Whether Sand Cast or Chill Cast: (Castings) Sand (Test Bars) Chill

Pouring Temperature: °C Highest Temperature acquired during Melting: °C

CHEMICAL ANALYSIS: Order No.: 675 Analyst: G. Spencer

Al	Cu	Zn	Sn	Pb	Fe	Si	Mn	Mg
86·61	2·54	9·65	·10	-	·54	·36	-	-

PHYSICAL TESTS:— Order No.: 675 Testing House: G. Spencer

Ultimate Tensile Strength Tons per sq. inch	12·6
Yield Point	8·5
Elongation % on inches	5%
Reduction of Area %	3·5%

REMARKS:

BOWLAND HILL & SONS, Ltd., COVENTRY. Form No. 190

FIG. 5.—PHYSICAL TEST AND ANALYTICAL REPORT FORM

If aluminium alloys are cast at an unduly high temperature the rate of solidification is necessarily reduced. Consequently, the crystals formed increase in size, and this is a symptom which is always accompanied by a decrease in strength. If test-pieces are taken as an example, the surplus heat of the metal increases the temperature of the already warm chill. thus reducing its chilling qualities, and affecting the physical properties. The moral, therefore, is that aluminium test-bars should not be poured at a temperature exceeding about 710 to 720 deg. Cent.

The superheating of the metal in the furnace. even though it be allowed to cool before the test-piece is actually cast, is also detrimental to the production of the best results. There may be

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some inclined to combat this statement, holding the view that, provided the metal is not actually burnt, no real harm ensues. It must be remembered, however, that all metals absorb and dissolve impurities, both gaseous and solid, with greater avidity the higher their temperatures are above their melting points. For example, aluminium will absorb, at a very high temperature, quite an appreciable amount of iron from the ladle used for stirring, also the silicon content will be increased by absorption from the wall of the crucible or furnace lining; and these occurrences militate seriously against the maintenance of the alloy at any given standard of composition or of physical properties.

Also, it is probably true that superheated aluminium combines more readily with oxygen forming Al_2O_3 (aluminium oxide), and unless this oxide is reduced by the addition of a flux such as 1½ to 2 per cent. of Mg. the excess oxide remains in solution, being expelled during freezing, to the crystal boundaries, thus forming an amorphous substance separating the crystals from each other. Naturally this would be a source of weakness, and would probably account for the frequently observed inter-crystalline cracks which sometimes characterise castings poured at too high a temperature.

Sample Castings

The statement made at the outset that one of the essential features of foundry management is the reduction to the absolute minimum of the

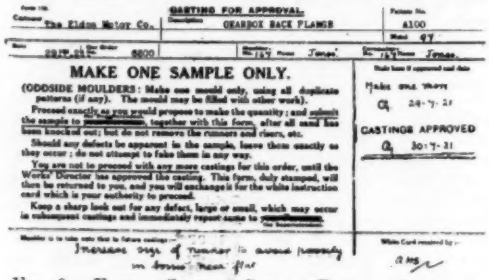
CASTING FOR APPROVAL.
The Eldon Motor Co.
GEARBOX BACK FLANGE
A100
MAKE ONE SAMPLE ONLY.
(ODDSIDE MOULDERS: Make one mould only, using all duplicate patterns (if any). The mould may be filled with other work).
Proceed exactly as you would propose to make the quantity; and submit the sample to ... together with this form, after all sand has been knocked out; but do not remove the runners and risers, etc.
Should any defects be apparent in the sample, leave them exactly as they occur; do not attempt to fake them in any way.
You are not to proceed with any more castings for this order, until the Works' Director has approved the casting. This form, duly stamped, will then be returned to you, and you will exchange it for the white instruction card which is your authority to proceed.
Keep a sharp look out for any defect, large or small, which may occur in subsequent castings and immediately report same to ...
CASTINGS APPROVED
Increase size of runner to avoid porosity in flange near flat

Fig. 6.—Flimsy Copy of Sample Casting Approval Form.

proportion of scrap castings to total output is equivalent to stating that foundry errors must be eliminated. The battle is half won if the first castings made off a pattern are made under adequate supervision. The battle is completely won, figuratively speaking, at any rate, if this special supervision is repeated at later dates, when further orders for castings off the same patterns are received—provided that the previous experience has been duly recorded in an available form and is subsequently utilised.

The primary function of the technical department is the supervision of sample castings. No pattern should be put into work for production without its express sanction, and this sanction should not be given until a sound casting has been made and approved. It is the business of the technical department to insist that the first casting off any pattern is properly run and sound in every way before permission is given to the production department to proceed with the order. The actual routine method devised and adapted by ourselves may be of interest.

When every order for castings is received in the general office a printed form, called "The sample approval form," or more familiarly the "Flimsy" copy, is typed out for each individual pattern. This form, shown in Fig. 6, is issued by the general office to the technical department. If the pattern is a new one, or new as far as the foundry is concerned, another similar, though not identical, form is typed out, called the stiff copy of the sample approval form, or in short the "Stiff" copy. If the pattern described on the "flimsy" has previously been in use in the foundry, no new stiff copy is made, but the original stiff copy is procured from the file.

These two forms, the flimsy and stiff copies of the sample approval form, constitute the mainsprings of the system. The flimsy copy is an authority for the moulder to proceed with one casting off the pattern whose number and description appear on the heading. The printed instructions to the moulder are shown in Fig. 6.

The flimsy is issued by the technical department to the foundry foreman, who hands it, together with the pattern, to the moulder whom he has selected for this particular job. The moulder then proceeds to make one casting as directed on the flimsy. As soon as the casting is cold enough the sand is knocked out, and the moulder sends it, together with the flimsy on which he has written his name and number, to the inspection branch in the technical department. It is immaterial whether the casting is obviously scrap or not; it has to be sent, as it came out of the mould, for inspection. The moulder has no authority to proceed with another casting off that pattern, for

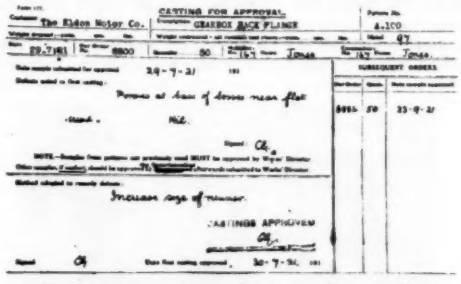
CASTING FOR APPROVAL.
The Eldon Motor Co.
GEARBOX BACK FLANGE
A-100
Increase size of runner
CASTINGS APPROVED

Fig. 7.—Front of Stiff Copy of Sample Casting Approval Form.

his flimsy is on the inspection bench with the sample. This first casting is made entirely according to the moulder's own idea of how the casting should be made. No one interferes with him, or makes any suggestion. He acts purely on his own initiative. The underlying motive is that this method encourages the moulder to originate the best method of tackling new patterns, and forms a valuable part of his experience.

The sample casting now on the inspection bench, with all the runners and risers on, is carefully examined by a member of the technical department staff. If, as is sometimes the case with new patterns, there are some defects, the flimsy is marked "make one more," and re-issued to the same moulder. Suggestions to overcome the difficulty are written on the bottom of the flimsy. Possibly, the gates and feeders must be placed differently, or chills should be added where a riser cannot conveniently be put, in order to overcome local porosity. If the defects, when such exist, are not easily explained in writing, the moulder is summoned, verbal suggestions are made, probably by both sides, and the moulder proceeds to make another casting on the new lines, the flimsy having been given back to him as his authority.

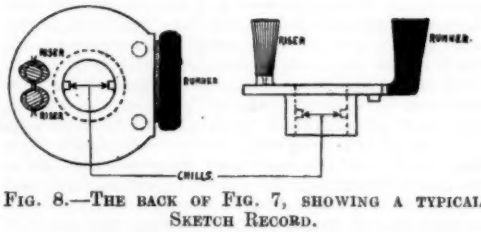

Fig. 8.—The back of Fig. 7, showing a typical Sketch Record.

It but seldom happens that a second sample when it is found on the inspection bench, accompanied by the flimsy, is incorrect; but should this be the case the trouble is further investigated, and still another sample made which is practically certain to be correct.

When the technical department is assured that a sample is sound, the casting is sent to be fettled and is subsequently returned for a more minute inspection. Of course it sometimes happens that certain defects are not observed until the gates are cut off, in which case a further sample has to be made.

When the technical department are satisfied that the casting is correct, the stiff copy comes into action. This form, shown in Fig. 7, has two functions. It first of all provides a detailed description of the technical history of the casting. If the first sample is not satisfactory, the remarks on the flimsy copy are also put on the stiff copy, the defects noted and the methods adopted to over-

come them being fully detailed. If the sample casting is sound, the stiff copy is marked "sample approved" and initialled by the works superintendent. The second function of the stiff copy is as follows:—Each casting off a new pattern is sketched on the back of the card. An elaborate diagram is not required, it being only necessary to indicate the position of runners, risers and chills. Any special points which can be made clearer by a diagram are also noted. A typical example is shown in Fig. 8.

Thus the stiff copy, which is made of thick cardboard, suitable for sketching, provides in an easily accessible form, for future reference, a

A duplicate of this Label appears on the Casting.

SAMPLE CASTING
FOR YOUR APPROVAL.

Please check dimensions, and ascertain if this Casting will meet all your requirements to your
ORDER No. ..... then send instructions to proceed to:—
ROWLAND HILL & SONS Ltd.
COVENTRY.

A duplicate of this Label appears on the Advice.

SAMPLE CASTING
FOR YOUR APPROVAL.

Please check dimensions, and ascertain if this Casting will meet all your requirements to your
ORDER No. ..... then send instructions to proceed to:—
ROWLAND HILL & SONS Ltd.
COVENTRY.

FIG. 9.—RED SAMPLE-CASTING LABELS.

diagrammatic illustration of the correct method, based on actual experience, of moulding a casting from a particular pattern.

Meanwhile, the sample casting has now been sketched and fettled. It is next sent to the pattern shop so that its main dimensions can be checked, if we are responsible for the making of the pattern. If the customer supplied the pattern this is not done. To all appearances, now, the casting is correct, and it is sent to the customer for his approval before the order is proceeded with.

In order that a customer may readily distinguish a sample casting, a distinctive red label is gummed on to it. One of these with a black corner is attached to the casting, and the other is sent with the advice note, which is enclosed with an accompanying letter and sent by post. The sample casting itself is despatched, if too large for the post, by passenger train, in contra-distinction to the general run of castings which are sent by goods. These forms are shown in Fig. 9.

When the customer's report is received, and the casting is approved by them, a technical department instruction note, to the production department, commonly called T.D.I., is issued, denoting that the casting in question has been approved and that the pattern is released for production when required. Further, the flimsy copy of the sample approval form, which in the interim between the despatch of the casting and the receipt of the customer's report has been filed with its accompanying stiff copy, is issued to the foundry foreman, who exchanges it for a white card at the general office, where the flimsy is now filed, its work having been done. The stiff copy is filed in the office of the technical department. The white card is the foreman's authority to proceed with the order, and a receipt for its issue is obtained by the production department as the foreman is required to initial in the space provided in the bottom right-hand corner of the flimsy copy. During the continuation of the order in foundry, the technical department is not directly concerned with the castings made, though the department's inspector keeps a watchful eye on the castings as they come through. It is not, however, this inspector's duty carefully to examine each casting that is made in the foundry, for this is done by the general inspection staff attached to the production department.

Should the customer's report on the sample submitted not be satisfactory, then the necessary alterations or corrections are made, and a second sample is submitted to them if necessary.

Proceeding with the case when fresh orders arrive for castings off patterns which have been previously used in the foundry. When the "flimsy" is received from the main offices the "stiff" copy for that pattern is withdrawn from the file in the office of the technical department. This form, of course, contains on the back a sketch made when that pattern was used for the first time. The value of the sketch can now be readily appreciated, for whatever time has elapsed since the previous order was received the correct method of moulding is known and no experimental work has to be done, with its consequent risk of scrap. The advantage is particularly noticeable when the casting is either large or complicated. The new flimsy copy and the old stiff copy containing the sketch are issued by the technical department to the foundry foreman, who gives the flimsy to the selected moulder and explains how the casting should be made. If possible, the flimsy is given to the man whose name appears on the stiff and flimsy copies, and who therefore made the previous sample. This cannot always be done, for various reasons, neither can the man who made the sample always conveniently be given the pattern when released for production, though this is desirable and is always done when possible.

When one casting, and one only, has been made on the authority of the flimsy, it is placed, when cold, on the inspection bench unfettled. This is examined by the technical department, before and after fettling, and if it is correct the flimsy is stamped and re-issued to the foreman, who exchanges it for a white card at the main office. In this case it is obvious that unless any material alterations to the pattern have been made no sample need be sent to the customer, who has previously approved the casting. Should there be any doubt on this point, however, it is better to err on the side of excessive caution rather than otherwise, for though naturally it is not desirable unnecessarily to delay production, yet the loss of production involved by the delay incurred in sending samples for approval is small in comparison with the loss that might be sustained if large quantities of incorrect castings were made.

Should the first casting made off the flimsy be incorrect, then a second one is made, which has every chance of being in order. The flimsy is then issued to the foreman as explained above.

It will be noted from Fig. 7 of the "stiff" copy of the sample approval form that on the right-hand side there are three columns provided for the purpose of recording the order number and quantity of all subsequent orders, together with the date of approval by the technical department of a sample casting for each order. Thus it will

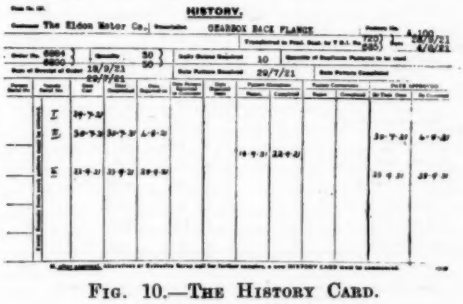
HISTORY.

FIG. 10.—THE HISTORY CARD.

be seen that the stiff copy provides (1) a record of difficulties encountered, if any, in the making of the first sample casting off that pattern and how the difficulties are overcome; (2) a sketch, on the back of the form, showing the correct method of moulding; and (3) a record of all subsequent orders received.

History Cards.

The system of making sample castings thus described is extremely efficient in practice, but it is highly important that there be no undue delay in carrying it into effect. For example, when a flimsy copy of the sample approval form is handed to the foundry foreman for a sample casting, the technical department must see to it that the sample is received within a reasonable time, or when the first sample made is defective and the flimsy is re-issued for another one, the second sample also must be received for inspection with-

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out undue delay. In order that the technical department may be kept in touch with all the castings and patterns which happen to be passing through their hands at the time, a special form called the "history" card, shown in Fig. 10, is made out for each particular pattern. This form gives the complete history of the casting, and gives, when kept daily up to date, the existing position of the pattern in question at a glance. The cards are filed in a box which has three main compartments. In the first compartment all history cards are kept whose patterns for some reason or other are not available for the foundry so as to get a sample casting. For example, the pattern may be in the pattern shop undergoing alteration or corrections, or it may have been returned to the customer.

In the second compartment the cards are filed whose respective patterns are in the foundry for samples. When the alterations or corrections to

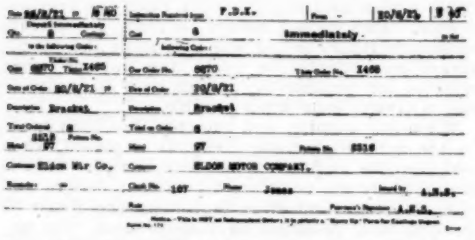

Fig. 11.—Front View of an Emergency Order Form.

the pattern are completed, or when the pattern is received back from the customer, the card is transferred from compartment 1 to compartment 2. All sample castings made off the flimsy copy are recorded on the history card whether they be defective or not, so that a record is kept of the number of castings which have had to be made before a sound one is produced.

When a sample casting is approved by the technical department and has to be sent to the customer for his approval, the card for this casting is transferred from the second compartment to the third, which contains therefore all history cards whose respective sample castings are awaiting the customer's reports.

When the report is received and is satisfactory the date and number of the technical department instruction note to the production department releasing the particular pattern for production are inserted in the spaces provided in the top right-

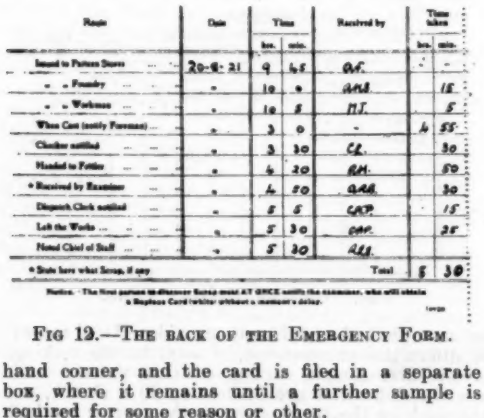

Fig 12.—The back of the Emergency Form.

hand corner, and the card is filed in a separate box, where it remains until a further sample is required for some reason or other.

The function of the history card is that it enables the technical department to watch every stage in the production of a sample casting and readily to check the time taken either to make, alter, or correct the pattern in the pattern shop, or to cast its sample in the foundry. In this manner it is assured that the sample castings are put through in the least possible time. Moreover, the history card shows what delay, if any, is actually due to the customer, owing may be to the time that elapses before his report is received; so that if a complaint is made that deliveries are overdue, the actual time spent in the making of the sample and the time taken by the customer to check it over are immediately available at a glance.

Emergency Orders.

There remains only one item of special routine which we will just mention. If castings off new or old patterns are very urgently required, the whole routine just described is laid aside and what is called a "Red Order" is issued. This order, shown in Figs. 11 and 12, is an authority to the foreman to make a specified number of castings without delay. No sample is submitted either to the customer or the technical department, though the progress of the castings is carefully watched by the technical department's inspector until the requisite number of castings is made.

A more or less detailed description has now been given of the routine methods adopted with the object of ensuring, first of all, that all castings are made of alloys uniformly correct as regards analyses and physical qualities, and, secondly, that the percentage of scrap is reduced to the absolute minimum.

That the systems described are efficient the experience of several years abundantly proves, and it is for this reason and with the hope that they may be of some interest and practical value to others that they have been outlined.

Book Reviews.

"Private Property and Rights in Enemy Countries and Private Rights against Nationals and Governments under the Peace Treaties with Germany, Austria, Hungary, Bulgaria, and Turkey," by Paul F. Simonson, M.A., Oxon. Published by Messrs. Effingham Wilson, 54, Threadneedle Street, London, E.C.2, and Sweet & Maxwell, Limited, 3, Chancery Lane, W.C.2. Price 36s. net. The author of this book, who is a barrister-at-law, has detailed the international arrangements made under the Peace Treaties for the regulation of private pre-war debts and properties or interests held in any of the States lately at war with their own country. To make this more clear, a complete examination of the various treaties has been made, and the whole of the main provisions dealing with privately-held property and interests in enemy countries have been printed *in extenso*.

The book admits of two main divisions, and is supplemented by thirteen appendices, Part I. summarising and explaining the provisions of the five Treaties, as regards private property, whilst Part II. outlines the full text of the Treaty with Germany. As this forms a model for the other treaties, and in order to emphasise the differences which exist between the German and the Austrian, Hungarian and Bulgarian treaties, the German Treaty has been printed on the right-hand side, and the variants on the left-hand side.

The appendix consists of the various Orders in Council and Rules made by the Anglo-German Mixed Arbitral Tribunal and the like which have been made for the carrying out of the treaties.

Die Werkzeugmaschinen für Metallbereitung. By Prof. Hermann Wilda (Part II.).—Berlin: Walter de Gruyter and Company, Genthiner Strasse, 38, W.10. (Price, 1s. 6d.)

Entwasserung und Reinigung der Gebaude.—By Wilhelm Schwaab. Berlin: Same publishers (Price 1s. 6d.)

These two little volumes are Parts 562 and 822 respectively of the Göschen Collection recently referred to in these columns. The former deals with metal-working machine tools, drilling machines, screw-cutting machines, grinding and milling machines, and the production of gear wheels by machine tools (milling cutters, shaping machines, slotting machines, etc.). The second little book deals with the draining and sanitation of buildings, including factories, workmen's dwellings, garden cities, etc. Both volumes are fully illustrated, the former with 128, the latter with 92 figures in the text.

The Testing of Cast Iron.—A Correction.—By an error the percentage of total carbon in Heat No. 6271 is given in Mr. Wheeler's letter as 2.16 (see page 295 of last week's issue). The correct figure should have been 3.26 per cent.

Institution of British Foundrymen.

LANCASHIRE BRANCH.

At the opening meeting of the session, held on October 1 at the Municipal College of Technology, Manchester, the following address was read by the Chairman (Mr. J. Haigh), who presided, in the absence of the Branch-President, Mr. W. H. Meadowcroft.

PRESIDENTIAL ADDRESS.

Emerson, the great American essayist, said that in times of doubt and difficulty it is helpful to sit down and have a good think. Obviously the present time is full of doubt and difficulty, and it will certainly do us no harm to sit down and have a good think on matters that are pressing themselves on our notice.

As to the future of the foundry, undoubtedly it will be very different from most of our present-day foundries. Now, more than at any time, it is essential that we should compare our position and practice with that of our competitors. We have ample opportunity for the study of American foundry methods from the literature that reaches this country. Profiting by our mistakes and the mistakes of others, America started at the foundry end in building up their engineering works, with the result that in repetition work they are enabled to get the best results. This is achieved by organisation and detailed study of methods and materials. Great sums are sunk in equipment and the provision of various labour-saving appliances. All this, together with an unlimited supply of alien unskilled labour, which obeys instructions without question and is paid by results, enables them to get a much greater production than we. Even in the larger castings they strive to cut out as much manual labour as possible. In studying the relative merits of American and British foundry practice it is necessary to bear in mind the great difference in the aims and ideals of the engineers and designers of the two countries. The American machines are designed with a view to massed production in every stage, including the foundry, and the engineer spends money freely in convincing the buyer that his machine is what the customer needs, whereas the British engineer has, in the past, followed every whim of the customer, with the result that we have not had full opportunity to develop the various manufacturing processes to their fullest extent owing to these variations. In no department is this felt more than in the foundry, and it is a question of vital importance to-day if we are to compete in the markets of the world.

In Germany we have somewhat similar practice to the American, for reasons which are rather different. The British foundry equipment manufacturer in the early days found their chief market in Germany, with the result that German foundries are, on the whole, much better equipped than ours for massed production, and will soon be keen rivals for our trade.

On examining our own position, the outlook is not discouraging, for we find that great strides have been made in recent years in developing foundries. It is true that the modern trend of foundry practice clashes with our traditional methods, but if we are to hold our own we must unhesitatingly scrap obsolete methods and plants which have long passed their career of usefulness and now serve but to impede our progress. It would not be a wise step to cut ourselves away from the old before we have something to take its place, but with all our modern research work and experiments to guide us, we are not taking a leap in the dark when we decide to do away with out-of-date methods.

In the haste to develop industry in the past we have to a great extent neglected the most important factor, the human element. Do not let us fall into this same error in our new efforts, because one-half the ills to which industry is heir have their root in this factor. The problems that we have before us in dealing with this branch of the industry are extremely difficult of solution, but they are not insoluble; but if they are approached patiently and with that wider vision which comes from an earnest study of the underlying causes, they will themselves show us their true solution.

Undoubtedly we do not get the best out of people by herding them together in the great modern works. Contact between craftsmen on one side and semi-skilled and repetition workers on the other inevitably leads to friction and unrest. It may be difficult to put our fingers on it, but it is there none the less.

All mass production workers should be effectively separated from craftsmen. The foundry of the future will be a series of well-lighted and lofty buildings, where the jobbing moulder will be well away from the repetition worker, and the latter work apart from the coremaker. The jobbing moulder will be a highly skilled craftsman, and will be paid well for good work, and it will be required that he shall prove that he is a moulder in another manner than by showing his Union card.

Another thing that will be essential if we are to learn more of our trade is that proper records must be kept of jobs of the medium and heavy type. A proper system of collating and filing this information would relieve the foundryman of a good deal of his worries, and obviate the necessity of racking his own and other people's memories in an effort to find what was done previously on a similar job. Memory is very illusive, and we want something better than hoary traditions on which to base our practice.

Formerly these matters were discussed at some length in the poor man's club (the public house), with varying results, but modern founding demands something better, and if such records are available it will tend to greater efficiency. It would, of course, be necessary to chronicle our failures even more clearly than our successes. We must tell the whole truth, for it is by our failures that we rise to better things. Given these records, we should still need the highest skill and experience in both the actual making and the supervision of the jobs.

Cast-Iron Research Association.

The formation of the British Cast Iron Research Association is due to the untiring efforts of our Institution. The list of officials and members shows it is well represented, and we are confident that it will prove a practical and permanent benefit to our trade. It certainly behoves us to take a keen interest in their work, for it will be most helpful to us. It is the intention of the Association to study the apprentice question, and try to evolve some scheme for special educational training in connection with a graded workshop course. If this difficulty is solved it will have overcome one of our greatest concerns, the supply of bright, well-educated boys for the foundry.

A higher standard of education for our boys is an obvious necessity if we are to progress; intelligent and receptive minds will be needed to absorb all that it is imperative to know. It is to be regretted that even to-day there are very few moulders who can read a drawing, and obviously the moulder's work would be far more interesting if he had an intelligent idea of the laws and forces that govern the exercise of his craft.

The pamphlet sent out by the Research Association sets out a comprehensive programme. The list is long and formidable, and it will need the close co-operation of all interested parties to achieve the object.

Metal founding is one of the oldest crafts, but founders have until lately been content to grope about in an atmosphere of mediæval gloom, and have not made much effort to improve methods with the times. In some of the smaller foundries, and even in some large ones, we see types of tackle and methods of moulding which might have been introduced by a Minister of Munitions of the time of Cæsar. Our trade has recognised this, talked about it for years, but has done little towards altering it until comparatively recent times. Even now we have not cleared the cobwebs from all the corners of the industry, and we shall have to leave it to the stress of an actively competitive business world to do this. Undoubtedly the Cast Iron Research Association will

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fill a great space that has been waiting for it, and thus will leave our own Institute unfettered to deal with matters of equal importance that lie in other directions.

The Institution.

The Institution of British Foundrymen has made great progress since its inception, in spite of great handicaps. The leeway created by ignorance and apathy in past days is being rapidly made up. Each year sees it enter on a period of greater activity. The successful conference held at Sheffield in 1918, after a lapse of three years, gave it a great impetus. In attending the Council meetings in various parts of the country one is impressed with the zeal, ability, and public spirit of the members, who often travel long distances to attend to the business of the Institution. There is every reason to be proud of having such men in our craft, and we were especially fortunate in having such a man as Mr. Riddell for President last year. This year one of our own Branch members, Mr. Oliver Stubbs, has been appointed to this high office. We congratulate him heartily on this signal honour, and we are confident that he will worthily maintain its high traditions. The Branch Council are determined to make the year of Mr. Stubbs' office a memorable one, and rely on the assistance of all members to make this possible. The first thing to do is to increase our membership. It ought to be possible to double our numbers. We must bear in mind that as time passes it will become increasingly difficult to become a member. The Royal Charter, when obtained, will give a much higher status to the Institution.

There are abundant signs that we are making our presence felt in the engineering world. A gratifying acknowledgment of our work has recently been made by the Ironfounders' Employers' Association in making a grant of 200 guineas to our Institution. Owing to generosity of some of our members, a scheme is afoot to grant medals and diplomas for good work done for improvement and education within the Institute.

Branch Conditions.

Turning to the Lancashire Branch, it is desirable that our members should submit any suggestion they may have for increasing our sphere of usefulness. Undoubtedly it would help all round if we could get more discussion and interchange of views at meetings. It would also be a great help if we could get our younger members to take a more active part in our meetings and discussions, for youth is synonymous with enthusiasm, and enthusiasm can accomplish much if it is tempered with the advice of the older and more experienced members.

The Lancashire Branch covers a very wide area, and it is the duty of the members to see that the Branch Council should be as widely representative as possible. It should be feasible to arrange small groups in various districts and appoint some rendezvous where they could meet and talk things over. The results of such meetings could be brought before the usual monthly meeting in this room, and would no doubt prove invaluable in extending and amplifying our work

It may be possible to arrange to have half an hour devoted to discussion of current problems; for instance, the types of pig-iron, coke, sand, etc., and it would make meetings more attractive and informing. It would be useful to have our members' experiences of some of the strange brands of pig-iron that are on the market at present. Much of this iron is bought through the office without the foreman moulder's knowledge, and he is then called upon to make the best of it, which he does, but with very variable results

Such questions as these have an immediate interest to the bulk of the members, and we must bear in mind that the chief value of our Institution is in the free diffusion of the experience and knowledge of our members. In the difficult period through which the industrial world is passing it is of the first import to us that we should come more closely together to try by the exchange of thought to do our part to bring about a more stable state of affairs.

The Annual Conference.

A question of much interest to us, raised at the Conference, was the need for greater co-operation with the moulders. Hitherto there has been a suspicion that our only concern was to obtain an increased output. While this is one of our chief objects, we must make it known that we intend to achieve this largely by improved plant and organisation and by better understanding, not by taking it out of the workman. To-day, social economics are very much to the fore, but we leave these severely alone; whatever ending these controversies have, we shall still need better foundries and better foundrymen. Taking an impartial stand, we can press steadily on with our task, and ask the help of the better elements of all interested parties. We have inherited much from the work of our forefathers; our plain duty, therefore, is to do our best to leave the craft in a higher position than we found it.

Unemployed Members.

In Mr. Stubbs' Presidential address he laid stress on the need of a register of our members who are unemployed. This is a question we have discussed often at our Branch meetings, and without doubt something ought to be done in this direction.

The very fact that our members devote part of their leisure time in endeavouring to improve themselves and the craft by attending our meetings entitles them to prior consideration when applying for responsible posts in the foundry. Some sort of a register is supposed to be kept at present, but the idea requires the consideration of the whole of our members. The more widely known the scheme becomes the greater will be its efficacy.

In connection with this, it may be mentioned that the proprietors of The Foundry Trade Journal have offered four free advertisements to any of our members who are subscribers and have the misfortune to be out of employment.

Mr. Hogg (the Secretary), in moving a vote of thanks to Mr. Meadowcroft for his address, said it was to be regretted that Mr. Meadowcroft could not be present on this occasion to put them before the members himself. He was not alone in that; other leading men in the Institution held the same view. They desired to encourage among the members a spirit of mutual aid, and an example of that was the offer of Colonel Cheesewright, referred to in the address. Whilst he had acted as Secretary many vacancies had become known to him, and in some cases he had been able to pass the information on to other members, to their advantage, but as the meetings were only held once a month and the firms who had vacancies to fill were usually anxious to do so quickly, it was too large a matter for one person to tackle, and he hoped some scheme would be brought forward. Personally, he saw no way of dealing with it without establishing a register.

The Chairman (Mr. J. Haigh) seconded the motion. He agreed that the Presidential Address gave them a good deal to think about. He hoped the members would show the same spirit as the President, and try to carry out the aims and ideals which had been placed before them, and make the Institution known in every foundry, not among the foremen alone, but also among the workmen, thereby creating a better atmosphere. The past ten years had seen more improvements in foundries than the previous fifty years, and there had sprung up a desire for better things. The industry could not move faster than according to the knowledge and education of the people with which they were dealing, but they must be ready to take advantage of that desire whenever it showed itself.

The vote of thanks was carried unanimously, and the members proceeded to the consideration of some technical questions.

Steel Business in Brazil.—A representative of the United States Steel Products Company, who recently returned from a business trip to Brazil, reports that the steel business in Brazil is at an absolute standstill. With abundant stocks in the ports, there is no effort made to move the steel inland. When the resumption of this movement does come a large volume of business will be created. The Germans are quoting low prices, but doing no business because of the general stagnation. Owing to the possibility of making quick deliveries by the new American steamer services between the United States and South America, Brazilians consider American firms in a good position to compete with Europe in this market.

XUM

American Standard Specifications for Grey-Iron Castings.

As there are to be discussions at the Branch meetings of the Institution of British Foundrymen concerning the general question of the testing of cast-iron, we give below the American specifications for cast-iron.

1. These specifications, which have been adopted as standard by the American Society for Testing Materials, cover three classes of grey-iron castings, as follows:—(*a*) Light castings, those having any section less than ½ in. in thickness; (*b*) heavy castings, those in which no section is less than 2 in. in thickness; (*c*) medium castings, those not included in either of the above two classes.

2. The tension test will be made only when specified by the purchaser and at his expense; but it is recommended by Committee A-3 on Cast Iron that the tension test shall not be made, for the reason that cast iron is almost devoid of elasticity, and hence any deviation from an absolutely straight pull in commercial testing machines yields defective results.

Manufacture.—3. The castings shall be made by the cupola process, unless furnace iron is specified.

Chemical Properties and Tests.—4. (*a*) Drillings taken from the fractured end of the transverse test bars shall conform to the following requirements as to sulphur:—Light castings, not over 0.10 per cent.; medium castings, not over 0.10 per cent.; heavy castings, not over 0.12 per cent.

(*b*) One sulphur determination shall be made for each mould of test-bars, cast, in accordance with the standard methods of sampling and analysis of pig and cast iron (serial designation: A64) of the American Society for Testing Materials. In case of dispute, the standards of the U.S. Bureau of Standards shall be used for comparison.

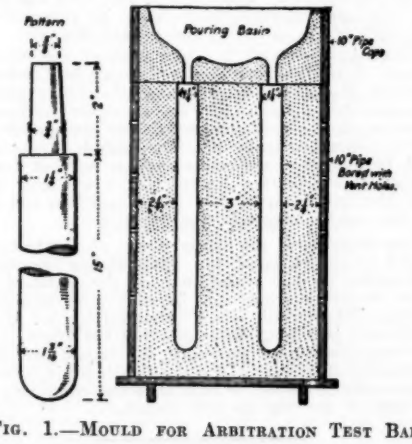


Fig. 1.—Mould for Arbitration Test Bar.

Physical Properties and Tests.—5. (*a*) The transverse test specimens (arbitration test bars) specified in Section 7 (*a*), when placed horizontally upon supports 12 in. apart and tested under a centrally applied load, shall conform to the following minimum requirements, interpreted in accordance with Section 9:—

	Class of casting		
	Light.	Medium.	Heavy
Load at centre, lb. ..	2500	2900	3300
Deflection at centre, lb.	0.10	0.10	0.10

(*b*) The rate of application of the load shall be such that a central deflection of 0.10 in. is produced in from 20-40 seconds.

6. When tension tests are specified, the tension test specimen shall conform to the following minimum requirements as to tensile strength:—Light castings, 8.0 tons; medium castings, 9.3 tons; and heavy castings, 10.7 tons.

7. (*a*) Arbitration Test Bar.—The form and dimensions of the mould for the arbitration test bar shall be in accordance with Fig. 1. The bottom of the bar shall be 1-16. smaller in diameter than the top, to allow for draft and for the strain of pouring. The pattern shall not be rapped before withdrawing. The flask shall be rammed up with green moulding sand, a little damper than usual, well mixed and put through a No. 8 sieve, with a mixture of 1 to 12 bituminous facing. The mould shall be rammed evenly and fairly hard, thoroughly dried, and not cast until it is cold. The test bar shall not be removed from the mould until cold enough to be handled. It shall not be rumbled or otherwise treated, being simply brushed off before testing.

(*b*) Tension Test Specimen.—When tension tests are specified, the tension test specimen shall be turned from any of the broken pieces of the transverse test specimens, and shall conform to the dimensions shown in Fig. 2.

8. (*a*) Two sets of two arbitration test bars each shall be cast from each melt, one set from the first and the other set from the last iron going into the castings. Where the melt exceeds 20 tons, an additional set of two bars shall be cast for each additional 20 tons or fraction thereof. In case of a change of mixture during the melt, one set of two bars shall also be cast for every mixture

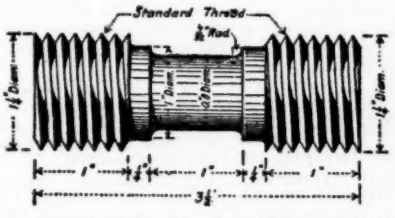


Fig. 2.—Tension Test Specimen.

other than the regular one. Each set of two bars shall be cast in a single mould.

(*b*) All arbitration test bars cast shall be tested as specified in Section 5 (*a*).

9. One arbitration test bar of each set cast shall conform to the requirements specified in Section 5 (*a*); otherwise the castings represented by such bars shall be rejected.

10. *Workmanship and Finish.*—The castings shall be true to pattern, and free from cracks, flaws and excessive shrinkage. In other respects they shall conform to whatever points may be specially agreed upon between the manufacturer and the purchaser.

11. *Inspection.*—The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the castings ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the castings are being furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

WROUGHT IRON GATES AND FENCING REQUIRED FOR NEW ZEALAND.—The Wellington Harbour Board has invited tenders for the supply and delivery of wrought iron gates and fencing for Waterloo Quay, Wellington. Tenders, which should be addressed to the Chairman, Wellington Harbour Board, will be received up to October 26. This information will only be of use to United Kingdom firms represented in New Zealand, who can instruct their agents by cable. Plans and specifications may be inspected at the offices of the Harbour Boards at Auckland, Wellington, Lyttleton, and Otago. Tender forms and schedules may be obtained on application to the Chief Engineer's Office, Wellington Harbour Board. A copy of the specification is on view in the Enquiry Room, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, while another copy is available for loan, in order of application, to firms in the Provinces who are unable to arrange for the inspection of the documents in London.

XUM

Trade Talk.

The Landore blast furnace of Baldwins, Limited, was blown in on October 7.

One of the Corby (Northamptonshire) furnaces, belonging to Lloyd's Ironstone Company, Limited, was blown in on Monday.

J. T. Eltringham & Company, Limited, Willington Quay, have decided to close their shipyard and engine works for the time being.

The employes of Messrs. D. & J. Tullis, Limited, engineers, Clydebank, have contributed £150 16s. to the funds of various local institutions.

We are informed by John A. Smeeton, Limited, that Mr. C. A. Midgley, who was recently a director of the company, is no longer connected with them.

Liverpool boilermakers have agreed to the removal of the restrictions on the use of burners, and have returned to work on the employers' proposals.

The offices of the National Federation of Iron and Steel Manufacturers have been removed to Caxton House (East), Tothill Street, Westminster, S.W.1.

The big rail mills at the Barrow Steel Works have been reopened after being idle for months, and the foundries will also restart. A considerable number of men who have been out of work for a long time will thus obtain re-employment.

The question of a reduction of freight rates, it is understood, was under discussion at a meeting of railway managers at the Clearing House last week, and an announcement on the subject will probably be made within a few days

The wages to be paid to the steel millmen at Consett during the months of October, November, and December, 1921, will be 95 per cent. above the standard, or, in other words, 60 per cent. below the wages prevailing during the preceding three months.

West Hartlepool ironworkers have suggested to Mr. Howard Gritten, the borough member of Parliament, that instead of paying unemployment doles to the men in November the Government should grant a capital sum to help restart the local iron industry.

The steamer "Slieve Donard" was launched from Vickers' shipyard, Barrow, recently. The vessel, which is for the London and North-Western Railway Company's Dublin-Holyhead service, will carry cargo and passengers, and will have a speed of 16 knots.

An important conference on economic recovery and world peace will take place in London next month, delegates from France, Italy, Germany, Holland, Hungary, Austria, Sweden, and Japan having promised to take part in the discussions on various phases of the subject

At Barrow-in-Furness, Mr. G. H. Banister presided at a farewell dinner to Mr. R. Pollock (who has recently retired from the position as manager of the shipbuilding side of Messrs. Vickers Naval Construction Works), Engineering-Commander R. Spence and Mr. G. A. Basset.

A report to the effect that the South Durham Steelworks was to close down is officially denied by the company, who wish it to be known that both their mills at Stockton and at Hartlepool are in operation and are in a position to deal with urgent orders for steel materials.

A report in a Canadian journal states that a valley of almost pure iron lying on the shores of Lake Athabasca has been discovered. An analysis shows 64.36 pure iron. It is alleged that blocks of ore are lying on the surface close to the lake ready for shipping without mining operations.

The N.S.W. Government is calling for tenders, closing October 31, 1922, for the construction of a bridge across Sydney Harbour. The length of the bridge is to be 3,816 ft. The deck is to include four lines for railway traffic, a roadway 35 ft. wide, a footway 15 ft., and a motor way 18 ft. wide.

The severity of Continental competition is indicated by tenders received by the Sheffield Corporation for tramcar tyres. Continental quotations were £2 8s. 3d to £2 15s. 6d. per tyre, and the British quotations varied between £3 12s. and £5 1s. per tyre. The lowest Sheffield tender has, however, been accepted.

At the 38th annual meeting of the North-East Coast Institution of Engineers and Shipbuilders last week the engineering gold medal was presented to Engineer-Commander C. J. Hawkes, for his paper, "Some Experiments in Connection with the Injection and Combustion of Fuel-Oil in Diesel Engines."

The average net selling price of No. 3 G.M.B. Cleveland pig-iron for the three months ending September 30 last is certified as 131s. 5.13d. per ton, as compared with 126s. 11.56d. per ton for the previous quarter. This gives an advance in blast-furnacemen's wages of 4½ per cent., raising them to 77½ above the standard.

The monthly report of the U.S. Steel Corporation shows that the unfilled orders on hand at the end of September amounted to 4,561,000 tons, an increase of 29,000 tons on the month. This is the first increase shown since July, 1920, when the unfilled orders amounted to 11,118,000 tons. A year ago the unfilled orders reached 10,375,000 tons.

A meeting of the executive committee of the Federation of British Industries was held on Wednesday to consider the problem of trade depression, and it was decided to appoint a representative committee to consider, in consultation with other interests, the suggestions contained in a memorandum which had been presented to the executive committee.

The opening meeting of the 29th session of the West of Scotland Iron and Steel Institute was held at the Royal Technical College, Glasgow, on the 14th inst., when an address was given by the president, Mr. Andrew Gray. Subsequently a paper was read by Mr. J. S. Atkinson (Messrs. Stein & Atkinson) on "Steel Works' Furnaces and Gas Producers."

Henry Berry & Company, Limited, of Leeds, have designed and put on the market a hydraulic press for steel railway sleepers. The presses are intended to be used in pairs; the first for keying the rails and punching the holes, and the second for forming. It is stated that if the blanks are well handled, and the machines not held up, a production of about three sleepers per minute or 180 per hour can be obtained.

The Eglinton Silica Brick Company, Limited, 45, Renfield Street, Glasgow, who are in voluntary liquidation, have disposed of their works to the Magnesite Company, Limited, Bale, Switzerland, who will carry on the business as manufacturers of magnesite bricks and other magnesite products, under the title of the Eglinton Magnesite Brick Company, Limited, Mr. Wm. Donald has joined the board of the new concern.

The twin-screw cable steamer "All America," built by Messrs. Swan, Hunter, & Wigham Richardson, Limited, at their Neptune Works, Walker, underwent her trial trip last week. The vessel, which is for the All America Cables, Incorporated, is a twin-screw cable-repairing steamer, about 295 ft. in length overall, with a length between perpendiculars of 270 ft., a breadth of 37 ft., and a depth moulded of 24 ft. 9 in

"The whole consuming power of the world is out of joint, and aggravated also by the confused condition of the exchanges," declared Sir Peter Rylands, president of the Federation of British Industries, recently at a luncheon at Glasgow, given in his honour by Scottish manufacturers who are members of the Federation. Apart from relief work and doles, he continued, unemployment must be approached in the light of the causes of the present distress.

The Administrative Committee of the National Union of Manufacturers, at a meeting in London on October 11, unanimously decided that every possible pressure should be brought to bear upon the Government to adopt the recommendation of the special committee set up to study the Merchandise Marks Acts, and to put the same into operation without further delay. It was further decided that it was most desirable that every imported article should bear the name of the country of origin.

The decision of the Special Court of Arbitration in regard to the claim of the Shipbuilding Employers' Federation for the withdrawal of the standard ship cycle of advances has been issued by the Ministry of Labour. The award, which is signed by Sir W. W. McKenzie, is a long document, but the effect is that the employers have succeeded in regard to three-quarters of their claims, and the remainder is continued temporarily in respect of such abnormal conditions arising out of the war as still remain.

Foundry Queries.

A Sand-Mill Trouble.

S.2. I have experienced the same trouble as "Anxious," and overcome it by using grooved rollers instead of the rollers he describes. In my opinion the rollers in the pan to which he alludes are no better than the plain ones, as they crush the sand grain as well as cake the sand.

I should suggest he uses three scrapers, one fastened to the centre and grooved, and the other two to be placed at an angle in order to throw the sand to the outside of the pan, so that when he draws the door, the sand will leave the pan. I feel sure if the scrapers are fixed properly and grooved rollers used the trouble will be overcome.

I should be very pleased to send a drawing to "Anxious," showing the method of fixing the scrapers, as by his letter this is the chief cause of his trouble. "E. M."

T.1.—Can any of your readers supply me with details of an electrolytic process for the refining of bismuth?—"F. K."

IRON AND STEEL MARKETS.

Pig-iron.

Reports from all the chief centres of pig-iron production indicate very slow progress in a revival of activity, and although last month showed some small increase in the number of blast furnaces in operation, from 46 to 67, the total is only an insignificant proportion of the plants in action during the normal period of the industry. It is, however, somewhat confidently anticipated in market circles that further developments may not be much longer delayed, and that consequent economies in the cost of pig-iron production following a realisation of lower fuel prices, and a drastic reduction in the present exorbitant railway freight rates may bring about a welcome change in the outlook of the trade. In the West of Scotland, business in the pig-iron trade is slow, and with an increasing production the output is not being wholly absorbed. In Scotland there are now 18 furnaces in blast, 16 of which are producing foundry qualities and the remainder hematite. Attendance at the Cleveland iron markets continues much below the average, and the tone remains languid, due, it must be admitted, to an almost total absence of buying interest and an abnormally inactive demand. The small volume of actual business passing in foundry iron is only of hand-to-mouth dimensions, just about equal to the producing capacity of the few furnaces now supplying that quality pig, which is quoted firmly and sells readily to home consumers at 120s. for No. 3, g.m.b., with an additional 5s. per ton for export. With regard to the price of No. 4 foundry, officially the price is unchanged at 119s., and that is a firm maker's price, but small lots can be got from second-hand at 114s. per ton. No. 1 is quoted 125s. per ton. No. 4 forge is down to 112s. 6d per ton f.o.b. and 125s. per ton delivered in Scotland, whilst for mottled and white makers are open to entertain offers, though the price is nominally at 112s. 6d. and 110s. per ton respectively.

The hematite section of the market continues weak, but there have of late been some fair deliveries of East Coast quality to South Wales, though the demand is not brisk, and makers who were quoting 130s. per ton a week ago are now prepared to accept 125s. per ton for mixed numbers and 127s. 6d. for No. 1. In West Cumberland and North Lancashire some difficulty is experienced in disposing of the output of the nine furnaces in blast, of which a substantial proportion of the make is low phosphorus iron for the Midlands and Scotland. One of the furnaces is on basic iron alone. Bessemer mixed numbers are quoted at £7 5s. per ton delivered at Sheffield.

Finished Iron.

The situation in this section of the trade is as yet unrelieved from its previous stagnant condition, and with few exceptions makers of finished iron justly complain of depleted order books, if not of the entire cessation of production. The recent substantial reductions in bar iron prices have so far failed to stimulate fresh business to any extent, and although important as bringing prices nearer to a competitive basis with foreign material, have had little visible effect in increasing demand. This is especially observable in the case of crown and ordinary bars, business in this department showing but little signs of improvement, the present heavy cost of production leaving makers a bare margin of profit when selling at £14 10s. per ton delivered Birmingham. With regard to the marked bar houses, conditions are on a somewhat different footing, the selling price, £17 10s., being regarded as reasonable, although still considerably above pre-war levels. Consequently, the mills devoted to the manufacture of marked brands of iron are in the exceptional position of having fairly well-filled order books, ensuring reasonably satisfactory work for some time in advance.

Steel.

The position in the steel trade continues unsatisfactory, and while in some departments a more hopeful view is entertained of an early improvement, conditions on the whole cannot be said to favour any general resumption of activity in the immediate future. The complete demoralisation of the world's markets for steel products, owing to financial stringency, is unquestionably the root factor in the prevailing slump, as illustrated in the decline in exports disclosed in recent Board of Trade returns, which show that with the exceptions of shipments overseas of electrical appliances and accessories and textile machinery, most of the leading lines in steel manufacture are below the average of previous years. Sheffield manufacturers on the whole, however, are not inclined to an entirely pessimistic view of the prospect, some encouragement being derived from a steadily increasing flow of inquiries, accompanied by some buying on overseas account, which, if limited in volume at present, may later develop to more substantial proportions. Other favourable points are the gradual deflation of prices and the diminishing margin between foreign and home quotations for all descriptions of steel materials. On the other hand, demand for Sheffield goods for the approaching Christmas season has been so far much below the average, and although a few occasional orders are placed in this connection, the bulk is insufficient to compensate for slackness in other departments. Prices continue on the down grade, the latest revision being in quotations for both Scotch and English steel, in which some drastic cuts are announced this week.

Tinplates.

As an exception to the general conditions of trade, the tinplate market maintains a fairly steady aspect, and with some good purchases recently on Continental account, and the Far East also buyers, production at the Welsh mills is now estimated at 50 per cent. of the normal capacity. Inquiries are now, however, on a somewhat reduced scale, and unless the demand improves it would not be surprising to see some mills compelled to close down for want of orders. There is a general feeling that prices are about as low as they can go for a while, and unless trade improves there will be keen competition for orders. Prompt plates are in fair demand, 22s. basis for ordinary sizes in coke finish being freely paid, but November plates can be bought at 21s. 6d., and even less would probably be accepted for delivery beyond this. Wasters are firm at 39s. 6d. for C.W. 28 by 20, while C.W. 14 by 18¾ are dearer at 16s. 3d. to 16s. 6d. per box; all net, f.o.t. Terneplates are steady at 21s. 6d. to 22s. basis, net, f.o.b., and there is just a little more doing in this class of plate lately.

Metals.

Copper.—Influenced by the steady improvement in the American exchange, the week's markets for standard copper opened with an easier tendency, and as it was early apparent there was an exceptionally heavy realising movement in evidence, values further weakened. Buying at the lower levels was, however, brisk, Monday's turnover amounting to 2,200 tons, the heaviest recorded since June. October was done at £66 10s. to £67, November £67 10s. to £67, with refined descriptions a shade easier, electrolytic and wire bars declining 10s. to £74 to £76 and £75 to £76 respectively. Closing prices.—Cash: Wednesday, £69 5s.; Thursday, £68 7s. 6d.; Friday, £67 12s. 6d.; Monday, £66 7s. 6d.; Tuesday, £65 15s. Three Months: Wednesday, £70 5s. Thursday, £69 10s.; Friday, £68 15s.; Monday, £67 12s. 6d.; Tuesday, £67.

Tin.—Favourable Eastern cable advices received on Monday reporting sales at £160 5s., c.i.f., an advance of 25s., stimulated a firmer tone in the week's markets for tin, and at the opening there was some good buying, America coming in for fair quantities, resulting in a sharp advance to £160 for the forward position. The close, however, was slightly below these figures, October selling at £155 to £157 15s.; November, £157; and December, £157 10s. to £159, New York, c.i.f., was bid up to £161. English ingots closed 30s. better at £155 10s. to £156 10s. The weekly return of tin stocks in London warehouses shows an increase of 313 tons, totalling at 4,310 tons; Liverpool stocks have decreased 41 tons to 2,068, but the Swansea stock is 105 tons heavier at 120 tons. Closing prices.—Cash: Wednesday, £155 15s.; Thursday, £155 10s.; Friday, £155 5s.; Monday, £157 10s.; Tuesday, £157 5s. Three Months: Wednesday, £158 5s.: Thursday, £157 17s. 6d.; Friday, £157 12s. 6d.; Monday, £159 15s.; Tuesday, £159 10s.

Spelter.—Business in this metal during the current week has been on a limited scale, consumers keeping off the market and buying being mostly restricted to parcels for galvanisers. Values consequently weakened to a small extent, but closed unaltered. Closing prices.—Wednesday, £26 12s. 6d.; Thursday, £26 12s. 6d.; Friday, £26 10s.; Monday, £26 5s.; Tuesday, £26 2s. 6d.

Lead.—With some slackening of consumption in evidence the market for soft foreign pig continues on the quiet side, with slight variations in values. Shipments from Spain continue short. English closing prices: Wednesday, £24 10s.; Thursday, £24 15s.; Friday, £24 15s.; Monday, £24 15s.; Tuesday, £24 15s.

XUM

Company News.

Oak Foundry, Limited.—Capital £10,000. Directors: C. Sangster, F. Warwick, and J. W. Stocks.

F. A. Welling & Company, Limited.—Capital £3,000. General merchants and dealers in iron, steel, metals, and minerals, etc.

Elliott Pruner & Company, Limited.—Capital £10,000 in £1 shares. Agricultural machinery manufacturers. Registered office: 19, Regent Street, S.W.1.

British Standard Centrifugal Pump Company, Limited.—Capital £3,000 in £1 shares. Registered office: Kent Green, Scholar Green, Stoke-on-Trent.

Wade & Butcher, Limited.—Capital £1,000. Manufacturers of and dealers in iron and steel and ferro-alloys, etc. Directors: C. L. Butcher and A. Williams. Registered office: 41, Eyre Lane, Sheffield.

George Wright (Rotherham), Limited. — Capital £15,000 in £1 shares, to carry on the business of general ironfounders, etc. Directors: J. A. Macdonald (permanent), C. H. Tripney, and F. W. Reed.

Glenboig Union Fire-Clay Company, Limited.—Profit, including £17,847 brought forward, £50,172; general reserve fund, £10,000; dividend, 20 per cent., less tax, for year, £21,000; carry forward, £19,172.

Thos. Smith's Stamping Works Company, Limited.—Profit, £26,413; brought forward, £11,671; interim dividend, 1s. per share, free of tax; final dividend, 1s. per share, free of tax; carry forward, £13,085.

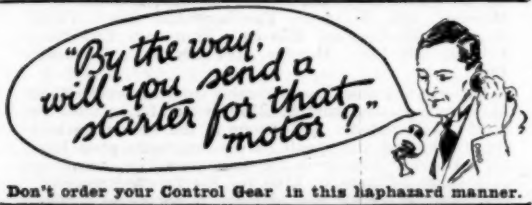
Tangent Tool & Engineering Company, Limited.—Capital £50,000. Directors: Com. F. S. Rising, E. Smith and A. R. Rawlinson. Registered office: Trafalgar Buildings, Northumberland Avenue, W.C.2.

Joymance (Brighton), Limited.—Capital £2,000. Gas meter manufacturers and repairers, etc. Permanent directors: A. G. Cooke (managing director), H. J. Green and W. H. Hammond. Registered office: Rose Cottage, Cambridge Grove, Wilbury Road, Hove.

Coltness Iron Company, Limited.—Profit, £111,014; written off for redemption and depreciation, £48,824; transferred from special reserve fund investments depreciation suspense account, £1,000; net profit, £63,190; final dividend, 3 per cent., making 6 per cent. for year; carry forward, £19,703; brought forward, £16,763.

Urquhart, Lindsay & Robertson, Orchar, Limited.—Capital £10,000 in £1 shares, to amalgamate the undertakings of Urquhart, Lindsay & Company, Limited, Blackness Foundry, Dundee, and Robertson & Orchar, Limited, Wallace Foundry, Dundee. Secretary: C. W. Tait. Registered office: Blackness Foundry, Dundee.

Every description of Steel Stamps made on the premises by ex-service men. 33 years' experience. Personal producer.
E. Dearman & Sons, — 8, Eldon Street, Sheffield.



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ELLISON ELECTRIC CONTROL GEAR

TRADING COMPANY.

R. S. STOKVIS & Sons

(Export Department)

ROTTERDAM.

BOILER TUBES
STAY TUBES

Enquiries solicited. Stock list on application.

MISCELLANEOUS advts., see also page 16.

FOR SALE, Foundry, West of England, including Building and Plant. Lease can be extended. Good trade. Price of the lot, £2,000. Plant worth the money. Full particulars on application to Box 884, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FINEST QUALITY SAND. Pits 12 miles London. Used extensively for large and small cores for oil sand mixtures in the production of heavy and light castings. Sample, quotation, and analysis from TALBOT ESTATES, 37, Pelham Road, Gravesend.

CAST-IRON SOCKET and SPIGOT PIPES, 12 in., 10 in., 9 in., 4 in., Valves and Spindles. English and/or foreign makes. Municipality of the Paarl, South Africa, will receive through their London Agents tenders for the supply of the above until November 7. For particulars and specifications apply to London Agents, E. W. CARLING & Co., St. Dunstan's Buildings, St. Dunstan's Hill, London, E.C.3.

WANTED sources of supply of Malleable Cast or Drop-forged Golf Club Heads, made of rustless Iron or Steel. Give full particulars and prices, etc., to Box No. 906, FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FIREBRICKS, 30,000 good second-hand Firebricks for disposal; offers wanted for quick clearance. —Box 914, FOUNDRY TRADE JOURNAL; Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

ORDERS WANTED for small Machine-made Castings in Brass, Gunmetal, Phosphor, or Manganese Bronze. Also Castings any size up to one ton in weight. Prompt delivery.—JAMES G. CROWTHER, Paradise Street Brass Foundry, Sheffield.

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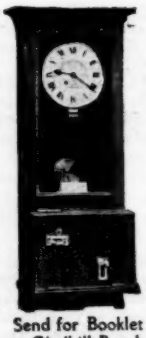

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